AATT National Airspace System Operational Concept Description (Volume I)

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Preface

This report was developed from the referenced documents in order to conform to the required contents of an Operational Concept Description (OCD) as jointly defined by National Aeronautics and Space Administration (NASA) and the Federal Aviation Administration (FAA) Free Flight Project Office. The majority of the descriptive material has been taken directly from the referenced documents available at the time of publication. Modifications have been made to add sections not in previous concept descriptions, to improve readability, and to reflect the most currently available information.

This approach to the development of this document was taken in order to remain faithful to the efforts that are presently being undertaken by the NASA Advanced Air Transportation Technologies (AATT) Project Office, the Tool Developers and the associated NASA AATT contractors.

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Overview

This document is the first volume of a two volume "AATT National Airspace System Operational Concept Description." It provides an operational concept for the future National Airspace System (NAS).

Volume One defines ten Enhancement Areas based on the NAS service model used by the FAA. The enhancement areas are: System Capabilities, Flight Planning, Separation Assurance, Situational Awareness and Advisory, Navigation and Landing, Traffic Management - Strategic Flow, Traffic Management – Synchronization, Airspace Management, Emergency and Alerting, and Infrastructure/Information Management. The operational concept for each of the ten Enhancement Areas is presented and a set of Applications in each Enhancement Area that are planned by the National Aeronautics and Space Administration (NASA) and the FAA are identified.

Volume Two provides a description of the applications contained within each Enhancement Area, with a bibliography for each. Appendix A is a table of acronyms and abbreviations. Appendix B is the complete bibliography. The entries include scholarly papers, conference presentations, and government and private organization publications.

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1. Scope

This Operational Concept Description (OCD) provides an evolutionary concept of operations for the National Airspace System (NAS) and an overview of the proposed enhancements to future NAS operations. The operational concept presented is built on the foundation of the 1997, 2000, 2001 and 2002 versions of the Advanced Air Transportation Technologies (AATT) Operational Concept (References 1,2,3, and 4). It highlights the potential changes and modifications to the NAS in a way that is easily identified by the reader. This document clearly identifies the needed enhancements to the NAS and the applications/projects that are proposed to partially achieve these enhancements.

This OCD documents the latest in an evolutionary path to analyze ATM requirements and provide an integrated and cohesive framework for subsequent concept development and assessment activities.

In Volume I, ten Enhancement Areas are defined based on the NAS service model used by the Federal Aviation Administration (FAA). The operational concept for each of the ten Enhancement Areas is presented and a set of applications in each Enhancement Area that are planned by the National Aeronautics and Space Administration (NASA) and the FAA are identified.

Volume II presents available information about each application. This presentation method provides the reader with a clear understanding of the projects and/or work that remains to be accomplished in order to meet the stated future needs of the NAS user and service provider.

1.1 Identification

This document is entitled "AATT National Airspace System Operational Concept Description (Volume I)". It applies to the National Airspace System in it entirety.

1.2 System Overview

Purpose: The AATT NAS OCD will be used by the AATT project in determining research directions and concept exploration and developmental activities. This document will be updated as necessary to reflect changes in FAA and user strategies. As rigorous concept evaluations and validations are conducted, and as AATT products reach maturity, this document will be modified to reflect the results of those efforts and to provide a more detailed definition and analysis of the modified concepts.

General Nature of the System: There are several possible ways to describe the operations of the NAS. These include:

- Functions - the description of the NAS by the major NAS functions, i.e., Communications, Navigation and Landing, Surveillance, Weather, Automation, and Management/Maintenance
- Domain - the description of the NAS on the Airport Surface, in the Terminal Area, En Route, Oceanic, and National domains
- Phase of Flight - the description of the NAS by phase of flight, i.e., pre-flight, pushback, taxi, takeoff, climb, cruise, descent approach, landing, taxi, docking.
- NAS Services - the description of the NAS by service area, i.e., Flight Planning, Separation Assurance, Situational Awareness and Advisory, Traffic Management Synchronization, Traffic Management Strategic Flow, Emergency and Alerting, Navigation and Landing, Airspace Management, and Infrastructure/Information Management.

The approach selected for this description of the operational concept is based on NAS services (Reference 5). This approach has been selected, in part, because there is an easily traceable mapping (i.e., many-to-one) mapping between the applications under study and development and NAS services.

Ten Enhancement Areas were defined based on the NAS service model. An additional Enhancement Area (System Capabilities) was added to the NAS service model to cover concepts and applications that did not fit into one of the original nine. The Enhancement Areas are:

1. **System Capabilities** - composed of four primary components:

- Enhancements to the NAS infrastructure;
- Technological standards by which NAS design shall be guided;
- Enhancements to the overall system capability that cannot be allocated to another Enhancement Area, which can include statements of overall economic, performance, or system requirements; and
- System changes required to accommodate new classes of vehicles such as Tilt Rotor, Expendable Launch Vehicles (ELVs), Reusable Launch Vehicles (RLVs), and Unmanned Air Vehicles (UAVs). This area includes infrastructure systems (e.g., Airport Surveillance Radars (ASRs), Air Route Surveillance Radars (ARSRs), Automatic Dependent Surveillance-Broadcast (ADS-B); automation systems themselves; and communications standards including communications interfaces and protocols, information transport, data and communications security.

2. **Flight Planning** - provides flight plan support for pilots and flight plan data processing. Capabilities include pre-flight and in-flight flight collaboration, plan filing, processing and usage, and the provision of flight planning information and development support. Collection and processing of proposed and amended flight plans and dissemination of approved instrument flight rules (IFR) and visual flight rule (VFR) flight plans are also included.

3. **Separation Assurance** - ensures that aircraft maintain a safe distance from other aircraft, terrain, obstacles, weather and selected types of airspace not designated for routine air travel. Capabilities include on-board and ground based separation functions on the airport surface and in the terminal, en route, and oceanic domains. Separation assurance results in a clearance from the controller to the pilot or in a command from an on-board system such as the Traffic Alert and Collision Avoidance System (TCAS) to execute an evasive maneuver.

4. **Situational Awareness and Advisory** - provides advice and information to assist pilots in the safe conduct of flight and aircraft movement. Capabilities include the development and dissemination of weather, traffic and NAS status information and advisories to enhance the situational awareness of pilots and controllers. This area also includes the generation of alerts including conflict alerts, terrain and obstacle alerts, severe weather alerts, wind shear alerts, wake vortex alerts, and microburst alerts. Normal IFR/VFR traffic advisories, automatic terminal information service (ATIS), and weather advisories including icing and clear air turbulence are also included in this area.

5. **Navigation and Landing** - provides electronic and visual guidance to pilots/aircraft to enable safe and efficient use of the NAS. Capabilities include airborne, landing, and surface guidance. Information is provided to pilots to determine their location from point-to-point during flight with and without visual reference to the ground. This includes navigation

reference definition, on-board navigation, remote determination of aircraft course and position, and approach and landing guidance.

6. **Traffic Management-Strategic Flow** - provides for orderly flow of air traffic from a national system perspective in order to maximize overall NAS throughput, flexibility, and predictability. Capabilities include long term planning, flight day traffic flow management, tactical Special Use Airspace (SUA) allocation, and traffic flow data archiving and performance assessment. This service strategically plans the number of aircraft using the national system to ensure safe, orderly, and efficient movement under varying operational conditions.
7. **Traffic Management-Synchronization** - supports the merging, sequencing and spacing of aircraft for efficient use of the NAS from the perspective of a local facility or group of facilities. Capabilities include synchronization of both airborne and surface traffic. This service tactically coordinates the number of aircraft using the local system to ensure safe, orderly, and efficient movement under varying operational conditions.
8. **Airspace Management** - ensures the safe and efficient use of airspace as a national resource through design, allocation, and stewardship of the airspace. Capabilities include airspace design and strategic management of SUA. Classification of airspace to balance the varied needs of user groups and the general public in a safe and efficient manner is accomplished by this service including the development of airspace structures, route structures, and aeronautical charts.
9. **Emergency and Alerting** - monitors the NAS for distress or urgent situations, evaluates the nature of the distress, and provides an appropriate response to the emergency. Capabilities include emergency assistance and alerting support. This area provides emergency assistance to local, state, federal agencies, foreign agencies and private entities in support of their aviation activities including: airspace and airport planning; procedures development; training; maintenance; flight inspection; charts and forms; and, law enforcement support. This area also includes flight monitoring and following, emergency assistance, and military and government operations assistance. In addition, search and rescue (SAR) alerts are initiated after determining that an aircraft may be overdue, lost, or downed and physical search activities are supported by providing information and direction.
10. **Infrastructure/Information Management** – ensures a safe and efficient NAS through management and operation of the air traffic control (ATC) infrastructure, by promoting the optimal use of the aviation radio spectrum, and through the dissemination of aeronautical information. Capabilities include monitoring and maintenance, communications management, and aviation information collection and dissemination. This area provides for the monitoring of all NAS systems. It also includes the management of infrastructure strategic resources, infrastructure systems, logistics, documentation, system status information, and operations and maintenance (O&M) data. It includes planning and managing communication resources including spectrum management.

    Support for NAS-wide information collection and distribution to all users and service providers including collection and dissemination of aeronautical information (i.e., aeronautical charts, flight information publications, air traffic control, Notice to Airmen (NOTAMs)) and weather information in support of safe and efficient operation of aircraft is also provided.

There are many potential applications that might be considered in this analysis. To narrow those down to a realistic scope, we considered only those applications that appear in NASA's AATT and DAG plans (and AvSTAR/NAS T plans in the future) and FAA's National Aviation

Research Plan (NARP), Capital Investment Plan (CIP), and Operational Evolution Plan (OEP). These applications represent projects that are likely to receive NASA or FAA funding in the near future. The enhancements to the NAS will be accomplished by the implementation of a series of proposed applications or projects that are included in the following categories:

1. FAA Operational Evolution Plan (OEP) (Reference 6)
2. FAA Capital Investment Plan (CIP) Projects (Reference 7)
3. FAA National Aviation Research Plan (NARP) Projects (Reference 8)
4. NASA AATT Distributed Air/Ground Concept Elements (Reference 9)
5. NASA AATT Decision Support Tools (Reference 10)

History of System Development, Operation, and Maintenance: The NAS has evolved rapidly in response to a rapid growth in demand for air travel, introduction of new aircraft types, and the introduction of new technologies in the air traffic and aircraft systems. The history of the development, operation, and maintenance of the NAS is documented in a variety of sources and will not be reproduced here. This section will concentrate on the recent planning activities of NASA, FAA, RTCA, and industry to further evolve the NAS to meet the challenges of 2015 and beyond.

In 1995, an industry/government task force developed an innovative concept called Free Flight (Reference 11). The task force report defined the Free Flight concept, evaluated the Free Flight architecture and technology needs, and identified an incremental transition to Free Flight. The Free Flight Steering Committee was established in 1996 to oversee the implementation of the recommendations of Task Force 3. During the same year, the RTCA Select Committee on Free Flight Implementation was established as the working arm and a consensus-building entity to work the detailed plans and activities within the aviation community. In late 1997, it issued the report "Government/Industry Operational Concept for the Evolution of Free Flight" (Reference 12) that further defined the Free Flight operational concept, evaluated the Free Flight architecture and technology needs, and identified an incremental transition to Free Flight.

Also in late 1997, the FAA issued the draft of the NAS Architecture Version 3.0 (Reference 13). Driving the architecture was a companion operational perspective embodied in the FAA Air Traffic Service's (ATS) Concept of Operations for the NAS in 2005 (Reference 14).

In December of 2000, RTCA updated the 1997 document and published the "National Airspace System Concept of Operation (Reference 15) and in November of 2002 updated and expanded that document in "NAS Concept of Operations and Vision for the Future of Aviation" (Reference 16)

In 1997, the AATT Project Office released the original version of the, "Air Traffic Management Operations Concept" (Reference 1). The 1997 document integrated the viewpoints of both the user community and the air traffic service provider, as well as provided these viewpoints in three time breakouts for the NAS; Current-2000, 2000-2005, 2005-Mature State. This Operational Concept was updated by the AATT Project Office in January 2000 (Reference 2), 2001 (Reference3), and 2002 (Reference 4) in reports entitled "Aviation System Capacity Program - Advanced Air Transportation Technologies Operational Concept. This OCD represents the 2003 update of this document and remains true to the objective of presenting a balanced vision of the future NAS that includes, blends, and integrates both the ATSP and the NAS user perspectives.

Project Sponsor, Acquirer, User, Developer, and Maintenance Organizations: The NASA AATT Project is the sponsor of the NAS OCD. The developers of the future NAS are the NASA Ames Research Center, Langley Research Center and the FAA. Both NASA and FAA are the developers of the NAS enhancements with NASA performing more of the initial research and FAA more of the final development and implementation. FAA is the acquirer, user, and maintenance organization for those enhancements that are selected for NAS implementation.

Current and Planned Operating Sites: The current NAS includes the personnel, equipment, facilities, and procedures necessary to provide a safe, secure, and efficient air traffic management system. The NAS exists in the Continental United States, Alaska, Puerto Rico, Guam, and also is responsible for traffic management in Oceanic and Offshore airspace. The planned operating sites are identified on an application-specific basis and are identified for each application in Volume II.

Other Relevant Documents: Documents relevant to this NAS OCD are found in Section 2.

2. Referenced Documents

1. Anon, *ATM Concept Definition, Version 1.0*; NASA Ames Research Center; October 1997.
2. Anon, *Updating the AATT Concept of Air Traffic Management Operations*, NASA Ames Research Center, January 2000.
3. Anon, *AATT Concept of Air Traffic Management Operations for 2001*, NASA Ames Research Center, January 2001.
4. Anon, *AATT Operational Concept for ATM Year 2002 Update (AATT02),* NASA Ames Research Center, January 2002.
5. Anon, *Capability Architecture Tool Suite – Internet (CATS-I)*, FAA Web Site: http://63.73.31.243/CATS/CATSI.cfm.
6. Anon, *Operational Evolution Plan v 5.0*, FAA, December 2003.
7. Anon, *National Aviation Research Plan 2000*; FAA, May 2002.
8. Anon*, Aviation System Capital Investment Plan*; FAA, May 2002.
9. Anon, *Concept Definition for Distributed Air/Ground Traffic Management (DAG-TM), Version 1.0;* NASA, January 30, 1999.
10. Anon, NASA Virtual Airspace Modeling System (VAMS) Web Site http://vams.arc.nasa.gov/.
11. Anon, *The Final Report of RTCA Task Force 3: Free Flight Implementation;* RTCA, 1995.
12. Anon, *A Joint Government/Industry Operational Concept for the Evolution of Free Flight,* RTCA Select Committee on Free Flight, August 1997.
13. Anon, *NAS Architecture 3.0,* FAA, 1997.
14. Anon, *Concept of Operations for the National Airspace System in 2005, Revision 1.3*; FAA, June 1997.
15. Anon, *The FAA Air Traffic Administration's Vision of the Future ATC System - 1992 to 2015*; FAA, October 1, 1992.
16. Anon, *NAS Concept of Operations and Vision for the Future of Aviation,* RTCA, 2002.
17. Anon, *FAA Order 7210.3S, Facility Operation and Administration*; August, 2002.
18. Anon, *FAA Order 7110.65N, Air Traffic Control*; August, 2002.
19. Anon, *Report from a Joint Committee of the FAA's Research, Engineering, and Development Advisory Committee and NASA's Aerospace Science and Technology Advisory Committee*, ATAG, 2001.
20. Anon, *Concept of Operations for Commercial Space Transportation in the National Airspace System: Narrative Version 2.0;* FAA, May 2001.
21. Anon, *The Air Traffic Management Operational Concept Panel (ATMCP) - Ninth Meeting Of The Working Group Of The Whole,* ICAO, 2002.

3. Current System/Situation

3.1 Background, Objectives, and Scope

The following description of the current NAS has been taken from *The FAA Air Traffic Administration's Vision of the Future ATC System - 1992 to 2015 (*Reference 15). It specifically draws on the section entitled "ATC System Methodology". This same document has also been published under the title *The U.S. Air Traffic Control System - Systems and Requirements - 1992 to 2015* (Reference 16). These documents, while somewhat dated, provide a comprehensive description of all aspects of the air traffic management (ATM) system. In the next edition of this OCD, those descriptions will be brought up to date.

The FAA provides ATM services for the National Airspace System (NAS). ATM services can be divided into both ATC services, primarily for the safe separation of air traffic, and traffic flow management (TFM), for the resolution of congestion problems.

The NAS is not defined by a single component or system, rather it is a complex collection of systems, procedures, facilities, aircraft, and of course, at the base of it all, making it all work, people. The NAS as directed by the FAA represents the overall environment for the safe operation of aircraft. This includes the aircraft itself, the pilots, the facilities, the traffic managers, the tower controllers, the terminal area controllers, the en route controllers, and the oceanic controllers. It includes the airports, the maintenance personnel and the airline dispatchers. All of this, with their computers, communications equipment, satellite navigation aids, and radars, are a part of the NAS.

The NAS supports all aircraft operations in the United States. Whether the user is a private pilot in Spokane, Washington, a military transport, a Federal Express aircraft over Ohio, a commuter flight in Connecticut, a transcontinental flight, or an inbound oceanic flight, these aircraft are operating within the NAS.

The NAS is far more than just the control of aircraft in flight. It covers every aspect of aviation in the United States, beginning with the aircraft itself. Whether it's in the earliest stages of design or thirty years after it enters service, the FAA is charged with certifying the aircraft for safe operations. The work of the FAA in this regard even goes so far as to include the certification of maintenance and repair operations, their practices and personnel, and even the certification of spare parts.

The FAA, in its management of the NAS, has responsibility for one of its key human components, the pilots. This includes setting standards for training, certification of pilots, time and duty rules, and medical screening.

Airports are perhaps the most fundamental component of the NAS. Whether it is a grass field in Custer, South Dakota, or a major hub airport like Chicago, the FAA sets standards for construction and operation of airport facilities. At present there are 18,292 public and private airports operating throughout the NAS.

On a larger scale, the NAS is a highly technical system and includes some 36,000 pieces of equipment operating in hundreds of locations throughout the United States. This can range from a lonely navigation beacon in Brooke, Virginia, to the very modern Air Route Traffic Control Centers (ARTCC) that handle the en route traffic. The mission of this highly integrated system is to support all phases of flight for aircraft in the United States, from initial flight planning to successful take off, en route operations, and landing. The system provides communications, navigation, surveillance, display, flight planning, and weather data to controllers, traffic managers and pilots.

The NAS is a logical integration of a number of control facilities, radars, computers, and communications systems. Operated by the controller workforce, a staff of some 15,000, they control the aircraft in the system and provide critical data through every stage of its operations. Included in this are the towers themselves, the 171 Terminal Radar Approach Control Facilities (TRACONS) throughout the United States, the ARTCCs that control aircraft in the en route environment and the three Oceanic Control Centers. All of these control centers are linked and managed through an Air Traffic Control System Command Center (ATCSCC) in Herndon, VA. All of these centers are operated and managed by FAA personnel.

In addition to this vast control and communication network, the NAS includes the provision of key and essential data for aircraft operations. This includes navigation sites that provide pilots with critical location information. To support this, the FAA operates thousands of sites throughout the United States that provide this information to pilots at all stages of their operations.

The collection of weather data and forecasts is a major concern in the management of the NAS. This information is critical for pilots, controllers and airline dispatchers who use this information in every facet of their operations. These information systems, ranging from the automated weather data systems at airports, to sophisticated forecasts of en route conditions, are vital to the safe and efficient operations of the NAS. The overall network of weather data collection sites, computers systems, and communications covers the entire United States.

3.2 Operational Policies and Constraints

The operational policies and constraints relevant to the present traffic management system are contained in the following documents (References 17, 18).

- FAA Order 7210.3S, Facility Operation and Administration
- FAA Order 7110.65N, Air Traffic Control

3.3 Description of Current System or Situation

Air traffic control is a highly complex process. In all phases of air traffic control, the key elements of input, process and output depend on close coordination among many sources and individuals, all working toward the same goal - the safe, orderly and expeditious movement of aircraft through the system. The process involves the consideration of weather factors, the current state of the facilities and systems that make up the NAS, traffic demand, coordination with the U.S. military establishment, and the current situation as it evolves tactically.

This section of the document discusses the methodology of ATC, looking at each of the primary categories of control activity as outlined in the previous section: preflight activities, the clearance process, control of aircraft as they move about the surface, and aircraft control in the airborne phase.

Preflight Activities: The preflight process begins long before the first requests come in to the FAA It is actually an ongoing activity of the FAA and the National Weather Service (NWS) to maintain current and forecast weather information for aircraft as they prepare for departure. The FAA also maintains dynamic databases of aeronautical information.

Every morning, long before the early morning activity on the east coast, a team of traffic management specialists (TMSs) in the FAA ATCSCC develop a traffic management action plan for the days scheduled activity, based on the airline schedules, filed flight plans, scheduled military activity, and weather and aeronautical information about the status of the facilities and equipment of the NAS. This strategic plan is designed to prevent demand on the NAS from exceeding its capacity. For example, a severe weather condition at any one of the nation' major airports can drastically change the airports capacity, as well as the procedures used by pilots and air traffic controllers. Since no two weather phenomena are alike, each day a unique strategy develops for minimizing delays that day.

When it is determined that a constraint exists in the NAS and that demand exceeds capacity, the action plan developed utilizes one or a combination of several traffic management procedures. This may result, for example in an aircraft being assigned a delayed departure time or being given a different route assignment. If demand exceeds the capacity of an airport, the TMS assigns each scheduled flight a controlled departure time, based on the scheduling information and the availability of arrival slots, or capacity, at the destination airport. Demand, therefore, is restricted and the number of aircraft arriving at the destination is controlled. Resulting delays are taken on the ground rather than in airborne holding patterns.

TMSs also coordinate with other air traffic facilities to develop alternate routes around severe weather in the en route environment. Such routes reduce the distance aircraft fly to circumnavigate severe weather and standardize the flow of traffic, reducing controller workload The purpose of these and other traffic management procedures is to minimize the time aircraft spend flying in holding patterns or around areas of severe weather, and to manage controller workload.

At the same time, airline dispatch offices, military base operations, commercial vendors, and the Flight Service Stations are gathering weather data and maps from the NWS and other sources to prepare forecasts and weather briefings for pilots. At a number of the nation's largest airports served by carriers with relatively constant schedules, automated pre-departure clearances (PDCs) are being formulated and disseminated to the airlines. The PDC process is designed to build into the system a constant that can alleviate a measure of the workload on controllers who formulate and issue clearances to IFR aircraft. These clearances are already in the computers, and form the baseline against which the rest of the days activity is compared and scheduled.

In the Flight Service Stations (FSSs), preflight briefers are gathering the data they use to inform pilots of the meteorological, aeronautical and traffic management information needed to make their trips. Preflight briefers get information from a broad range of sources including pilots reporting on weather and turbulence experienced in flight; from airport management, who provide details of specific activities at the airport that may have an effect on operations; from fixed base operators, who report conditions at smaller airports that do not have any on-site weather services; from other positions at the FSS; from the ATCSCC, whose specialists send advisories concerning traffic management programs and procedures; and aeronautical data from published FAA NOTAM documents; and from the NAS computers. Preflight specialists receive a complete briefing from the specialist whose place they are taking, and from the data listed above; thereafter information is automatically updated.

There are several automated systems that are part of the preflight process, some of which are unique to particular facilities, and others that are common. In the IFR ATC environment, weather data from NWS and other sources is routed to the FAA through the National Airspace Data Interchange Network (NADIN), the central data switch through which all information bound for the FAA passes for dissemination to the proper facility. NADIN interfaces with the Host Computers and the Central Weather Service Units (CWSU) in the ARTCCs, and with the Flight Service Data Processing System (FSDPS), the main processing systems that combine aeronautical and meteorological data as part of the Flight Service Automation System (FSAS). Through the NADIN switch, the FSDPS connects the 61 Automated Flight Service Stations. This system is the principal interface for FSS-generated flight plans prior to entry into the Host computers. The FSDPS includes two Aviation Weather Processors (AWP)--central computers that collect weather data from a variety of sources--and is served by the Weather Message Switching Center (WMSC), which disseminates the weather information to the FSSs.

When a pilot requests a preflight briefing from the FSS, the briefer provides a standard briefing. Based on that information, a pilot makes a go or no-go decision, a VFR or IFR decision, and a file or not-file decision. If the pilot decides to file, the flight service station specialist enters the data into the FSDPS. The specialist reviews the flight plan for accuracy and forwards it to the appropriate destination: the Host Computer in the ARTCC if the flight plan is IFR, or the in-flight position if the flight plan is VFR. The briefer also informs the pilot of traffic management procedures in effect for either the departure or the destination airport.

International flights have additional preflight activities that are dependent upon which oceanic ARTCC will control the flight. Pilots crossing the Atlantic will review and select the fixed route available *for* the time period they plan to fly. Daily route information is provided to airline operations, flight planning services and flight service stations by ATCSCC advisory messages. Those aircraft not traveling along fixed oceanic routes will develop minimum time track routing to their destination. Final oceanic routings will be taken care of in the en route phase of flight. Pacific flight routings and pre-planning are managed through the Track Generation and Track Advisory portions of the Dynamic Ocean Track System (DOTS). Daily DOTS generated flexible and fixed oceanic route information is transmitted to aircraft operators by the controlling ARTCC. Electronic nonverbal communications is used to coordinate priority route selections of each aircraft based on proposed departure time with the ARTCC responsible for Pacific operations. The ARTCC subsequently advises each operator of the most likely route that it can expect for each flight.

The Clearance Process: The clearance process as it relates to air traffic control is the focal point for systems operations. The surface movement and airborne phases of the ATC system would never occur without the formulation, issuance, and receipt. of clearances. The formulation of data originates in the Flight Service Stations, and with the help of flight service specialists and several automated systems the clearance process begins to unfold.

The primary data relay for clearance information is the NADIN. The NADIN sites are located in Atlanta, Georgia, and Salt Lake City, Utah. NADIN interfaces with the Flight Service Data Processing System (FSDPS), the principal interface system for FSS-generated flight plans. All flight plan information concerning sir traffic clearances is routed through NADIN, which in turn assesses the data and transmits the information to the appropriate address via direct interface with the Host Computers in the ARTCC.

The ARTCC Host Computers are directly interfaced with Interfacility Flow Control Network (IFCN) computers located at the DOT’s Volpe National Transportation System Center (Volpe) in Cambridge Massachusetts. The IFCN computers, used by the ATCSCC and other traffic management units, receive flight plan data from the Host Computers and update a database of scheduled flights. If traffic management procedures are in effect for the destination airport, a controlled departure time is assigned to each flight plan via this interface.

Thirty minutes prior to the proposed departure time, the Host Computers generate a flight progress strip and send it to the ATC facility responsible for issuing the clearance. This includes air traffic control towers, and appropriate sectors when the departure airport falls under the jurisdiction of an en route controller. The actual process of issuing the clearance can begin when flight data formulation and processing is completed.

Terminal Clearance Process

The majority of clearances issued to aircraft in the terminal environment originate from the Clearance Delivery position (CD). The process begins with the receipt of a computer-generated flight progress strip processed by the Host Computer in the ARTCC. The flight progress strip contains clearance items pertinent to that aircraft, including aircraft identification, clearance limit, departure procedure or standard instrument departure (SID), route of flight, altitude, transponder code, frequency information, and any other special information deemed necessary. The strip is routed to the Flight Data Input/Output (FDIO) located at the CD position. Strips received by the CD position are for aircraft that will operate under IFR. Upon request for a clearance by a pilot, the CD position issues the clearance, and routes the flight progress strip to the appropriate ATC position that will handle the first movement of the aircraft.

Additional clearances issued by the CD position include Tower En route Control Service (TECS), Terminal Control Area (TCA), Special VFR (SVFR), and VFR-on-top. The tower en route clearance is utilized to control IFR en route traffic that will operate entirely within delegated airspace between two or more adjacent approach control facilities. The advantage of the TECS is to expedite traffic and reduce control and pilot communications requirements in a high density area. The TECS data is transmitted via the Host Computer to the FDIO and is issued in the same manner as IFR clearances. TCA, SVFR, and VFR-on-top clearance are occasionally requested by pilots on the ground. The CD position obtains clearance from the tower cab Flight Data (FD) position or formulates the clearance based on the pilots request. Once issued, the CD ensures that the flight plan data for TCA, SVFR, and VFR-on-top clearances are received and recorded accurately for processing by the tower cab flight data position.

Very often the radio channels used for clearance delivery can become extremely congested. This is attributed to a number of factors. One factor is that the clustering of departures at certain times of the day causes a large number of clearances to be given in a relatively short period of time. Another is the random, sometimes uncontrolled nature of communications on the CD frequency. This is due mainly to the fact that pilots are initiating requests at a high rate and are competing with each other for air time. On most other ATC frequencies, communications are usually initiated by the controller, resulting in better frequency utilization.

These factors, and the continued growth in air traffic, were the basis for the development and implementation of the PDC system. A PDC automation system has been developed employing a datalink between the control tower FDIO system and specially-equipped aircraft or user flight planning computer system. Data for PDC clearances are presented to the CD position on a terminal display in the form of a tabular list in the flight plan display area. CD may append the flight plan by including any necessary local restrictions or information before relaying the clearance. The resulting departure clearance is then transmitted to the participant network computer via a data communications transfer link. The PDC process virtually eliminates the need for verbal communications with participating aircraft and reduces the amount of frequency congestion, especially during peak traffic periods.

The Clearance Delivery position located in the TRACON is responsible for issuing IFR clearances and obtaining approval for the release of IFR aircraft at satellite airports--airports located within terminal control airspace, but with only a VFR tower or without a tower. The CD controller issues clearances from flight plan information processed by the FDIO, and delivers departure strips to the appropriate radar sector.

Additional clearances generated at the TRACON are initiated by the radar controller. There are numerous types of clearance requests made by aircraft while airborne. These include aircraft with an IFR flight plan originating from a satellite airport, departing VFR and requesting a clearance in the air. Occasionally a VFR aircraft makes radio contact with the radar controller requesting an IFR/airfile. VFR, VFR-on-top, Special VFR, and TCA clearances are just a few of the requests a radar controller may receive while on position. The techniques may vary but the process for issuing a clearance is the same. The radar controller first establishes radio communications. Then radar identification, or position verification with non-radar aircraft, is attempted. Once this is accomplished, a clearance is issued based on data the controller receives from the pilot. The controller ensures that the flight plan data is properly received, recorded, and processed.

International flights across the Pacific receive their clearance to and through oceanic airspace at the departure airport. Atlantic tragic will receive their oceanic clearance during the airborne phase, just prior the entering oceanic airspace.

En route Clearance Process

En route clearances are issued from two positions, the Radar Associate (RA), and the Radar Controller (R) Position. En route flight plan data is processed by the host computer and transmitted to the FDIO, which generates flight progress strips at the appropriate sector. These strips are reviewed by the RA for possible conflicts, and used for coordination purposes with other ATC sectors and facilities. Strips generated for departures directly into en route airspace are used by the RA to issue clearances in the en route environment. If a pilot is unable to contact the controller from his airplane, he or she initiates a phone call to the appropriate FSS requesting an IFR clearance to his destination. The flight service specialist contacts the ARTCC RA controller via the voice communications equipment used in ARTCCs. Once voice communication is made, the RA controller issues the clearance using the standard format including a clearance void time. This prevents the airport and the surrounding airspace from being unusable for extended periods of time because of expected departures. Additionally, the RA is responsible for issuing clearances to VFR towers. The process is similar to the one described above, except that the VFR tower initiates the call to the RA position. Once the clearance is issued by the RA position, no other instructions are given unless the RA determines that a possible traffic conflict exists. In this instance a hold-for-release time is issued in conjunction with the clearance. When all traffic conflicts are resolved, the RA contacts the VFR tower and cancels the hold. The RA controller coordinates all clearances of this nature with the radar controller.

The remaining clearances in the en route environment are issued to airborne aircraft. These duties are designated to the R controller. VFR, IFR/airfiles, and VFR-on-top are issued in the same manner as by the terminal radar position. First radio communications is established Then an attempt to identify or verify position of non-radar aircraft is executed prior to the issuance of the clearance. The R controller ensures that the flight plan data is received and recorded. Once this is accomplished the R controller forwards the data to the RA controller for processing. After the clearances are issued and verification of receipt is accomplished, the process of movement control begins.

Surface Movement Departure Phase: Controlling the movement of aircraft traffic on the ground is a highly complex task that depends on coordination of numerous inputs and decisions, and prompt communication among all the various participants. Air traffic controllers make decisions based on information provided to them from three basic sources: data generated by computers and radars; information received on the radio, the telephone, and from others in the tower; and the airport environment seen visually out the windows of the ATC Tower.

The responsibility for controlling departing traffic on the ground lies primarily in the hands of two controllers or teams of controllers, ground and local controllers. Each has different responsibilities and actions to take, but their success depends on close coordination.

Tower controllers analyze myriad information to determine the priority of their duties. The information comes from a variety of sources. Visual or verbal input comes from observing the movement area and coordinating activities with other tower cab positions, the Terminal Traffic Management Unit (TTMU), and from the Area Supervisor (AS). Voice communications input comes from pilots in aircraft awaiting instructions, other positions in the tower, airline dispatchers, ground service personnel, and a variety of other sources including flight service stations.

Tower controllers receive data from several automated systems, including both traffic observing and weather systems. For tracking aircraft movement, controllers have access to an automated tower display (BRITE) system connected to the primary terminal computer system, the Automated Radar Terminal System (ARTS). The ARTS computer processes radar data received by the Airport Surveillance Radar (ASR-7, 8, 9 and 11) and secondary surveillance beacon systems that communicate with aircraft transponders, and displays them as targets with alphanumeric identification tags on the tower displays. Many airports also have Airport Surface Detection Equipment (ASDE) radars, which survey and display movement about the airport surface. In addition, tower controllers receive data from the NAS Host computers in the form of flight progress strips, which detail all the pertinent information about each IFR flight.

Tower personnel have weather data at their disposal from several sources, including the airport surveillance radars, which process and display weather phenomena directly on the BRITE display, the Automated Weather Display System (AWDS), and the Low Level Wind Shear Alert System (LLWAS). In addition, the Runway Visual Range system provides automated data regarding forward visibility for aircraft on final approach.

Field status information is provided by several systems that display information to the tower, including field and approach lighting panels that indicate the status of the lighting systems on the surface, coordination lights that assist in the movement of traffic, and a NAVAIDS panel that displays the status of the various navigation systems in the area.

Using this data, controllers project and plan traffic flows about the airport surface based on traffic management considerations, pilot requests, facility procedures, weather and field conditions, and aircraft performance. They obtain, review, amend and mark the flight strips to keep the information on the strips up-to-date; ensure that the information about aircraft movement is disseminated to pilots, ground vehicle operators and other tower cab positions; issue traffic and weather information and current airport conditions; issue ground movement instructions and ensure that pilots have received current airport, weather, and departure information (ground controller); issue takeoff clearance and transition instructions in the airport traffic area or control zone (local controller); record the information concerning aircraft movement; and forward flight data to the next facility via interphone and on the computers.

There are two other positions that contribute to the movement of aircraft about the airport, the flight data position and the gate hold position. The flight data position primarily relays flight plan and airport information to other tower positions, working closely with clearance delivery for coordination. The flight data controller analyzes information to determine the priority of duties; reviews, amends and marks flight strips as necessary; monitors and operates the NAVAID panel, ATIS, and FDIO; and ensures that the other tower controllers get any information that may affect operations.

The gate hold position analyzes traffic management requirements and implements gate holding procedures; records call up times (the time a pilot calls ready to push back); and maintains the sequence of departures based on the call-up times or flow control requirements. The gate hold controller is responsible for informing pilots when departure delays exceed or are expected to exceed 15 minutes. The gate hold controller delivers aircraft to the ground controller in an orderly flow to minimize congestion on the movement area. Pilots monitor the gate hold radio frequency for engine start-up advisories, changes in delay status, or new proposed start-up times.

Airborne Phase: The airborne phase involves three separate sets of activities terminal en route and flight service operations. These areas are different both in function and in the equipment and systems used to facilitate the activities of controllers.

Terminal Operations

Control in the terminal area actually begins long before an aircraft enters terminal airspace. A flight progress strip is generated at the TRACON by the Host Computer, and a data block appears on a radar screen at the appropriate radar position. The radar positions design and configuration are flexible, and can be set up in various ways, depending on how a position is to be used, and whether it is for departure, arrival, or satellite operations. Departure positions primarily deliver departing aircraft from one or more airports to adjacent air traffic control facilities or out of terminal airspace. Arrival positions primarily sequence aircraft delivered from adjacent sectors or VFR pop-up aircraft to the destination airport. Satellite positions normally provide arrival and departure service for secondary or military airports within the terminal area. Generally, these aircraft are incorporated into the primary airport flow of traffic.

Each radar position is assigned a defined segment of airspace, with appropriate maps on the display for the position. The level of service and separation applied to individual aircraft is dependent on a number of factors, including pilot requests, flight plan and aircraft types, and weather.

Controllers manage flight progress strips, scanning the strips, analyzing the information, transferring strips when necessary, making necessary progress markings on the flight strips, and filing them in a bay for easy access. The controllers correlate the flight progress strip information with radar display information.

Controllers analyze traffic factors such as volume, aircraft type and performance, pilot requests, weather, equipment status and traffic management considerations, and develop an action plan to manage the traffic under control at that position. Part of the responsibility for the activity’s to continuously evaluate the effectiveness of the action plan and make corrections if necessary.

Controllers receive input from various sources, voice and data communications, and automated messages and weather from the computers. Contact with the aircraft is established when the pilot reports position to the controller. In addition to the pilot request, the controller is receiving information, inputs to help make decisions. Again, there are voice and automated data inputs. The voice inputs include pilot reports (PIREPS) by radio from other aircraft; coordination from the towers, other TRACON positions, and adjacent ATC facilities; the TTMU; and the AS. Voice communications are controlled and routed in the same manner as communications to the tower.

Data inputs include both aeronautical data and weather. The controllers radar display shows aircraft data blocks based on data received by ASR equipment, beacon information received from aircraft transponders, and information entered by the controller. The data is processed by the terminal computers (ARTS). Terminal radar controllers also receive data inputs from the RVR, and weather data from the AWDS and the LLWAS.

En route Operations

Air traffic control in the en route area is performed in a similar fashion to the terminal area. Each sector in the ARTCC is a distinct segment of airspace, within which a radar controllers primary responsibility is to maintain separation. Depending on the projected traffic volume through a sector, the radar controller may receive assistance from additional personnel assigned to the sector. In addition to the radar position, there may be a radar associate controller and a radar coordinator. It should be noted, however, that the functions of the positions are interchangeable and do not always imply separate positions. As the volume of traffic increases, the team of controllers at a sector gets larger, to relieve the radar controller of tasks that may distract attention from the display.

As an aircraft enters a sector, the pilot makes contact with the radar controller monitoring and controlling the sector. In advance of a flight entering the sector, the radar controller receives a flight progress strip, and the information on the strip is correlated with that presented on the display. As aircraft make their way through a sector, the controller passes necessary information to the pilots and monitors their progress.

The radar controller receives input from various sources in order to plan and accomplish the task separating aircraft. The inputs come in the form of voice and automated data. The voice data includes radio transmissions of pilot requests for information or advisories, PIREPS on events encountered in the sir such as weather or turbulence, significant meteorological events (SIGMETS), and coordination from other radar and non-radar positions in the ARTCC and from adjacent ATC facilities. In addition, the controller receives advisories and instructions from the Traffic Management Unit in the Center.

The automated input to the controller includes the information presented on a digital radar screen known as a plan view display, or PVD. The PVD presents information to the controller about the sector being controlled. The PVD displays a map of the sector, including any necessary notations that affect the movement of traffic, such as airways and airway intersections, areas of restricted airspace, etc. The screen shows a data block for each aircraft operating within the sector, including a notation of altitude, airspeed, aircraft identification, and a discrete four-digit identification number assigned to the flight by air traffic control for that flight only. The information presented on the PVD is processed by the ATC Host computer based on inputs from the Traffic Management computers, the daily airline schedules, aircraft beacon transponders, the ARSR, and military operations units. In addition, the PVD displays the status of all flights in the sector in table form.

The en route sector controllers track the progress of aircraft on flight progress strips, similar to those used in the terminal area. The flight progress strips are generated in advance of a flights entry into a sector, and are amended as necessary as aircraft make their way across the sector.

Weather data is another form of automated input received by the Center. Each ARTCCs equipment includes a CWSU operated by NWS meteorologists. These personnel receive up-to-date weather reports from the NWS, satellite weather observations, and reports from other weather observing sources, and present to controllers information about changing weather conditions that may affect operations. The CWSU meteorologists constantly revise their forecasts to present the clearest possible picture of current and short-term forecasted weather events. This is a critical function in the center, as the movement of a weather front through an area can affect vast numbers of operations.

The sector controller or controllers receive input from the Area Supervisor in Charge, who coordinates the activities of the controllers, the meteorologists, the Traffic Management Unit, and other ATC facilities, and presents needed information to controllers.

The Radar Associate (RA) also provides input to the radar controller, maintaining watch over the operations by tracking the progress of aircraft through the flight progress strips. The person in this position reviews the flight strips for possible conflicts, and advises the radar controller that an action needs to be taken. In addition, the RA controller receives and reviews information relating to departures that transition into en route airspace directly from airports not located within terminal airspace. This information is received from Flight Service, and is recorded and entered into the system so that the aircraft may be tracked by the Host Computer and the radar controllers. The RA ensures that all flight strips are accurate and in the proper place, so that the radar controllers information is available when necessary.

The radar controller uses all this information to analyze the evolving traffic situation in the sector and issue control instructions, safety alerts, traffic and weather advisories and information to pilots. In addition, the R controller updates the Host Computer and the Direct Access Radar Channel (DARC) backup system, based on actions taken at the sector. This position is also responsible to coordinate with other positions in the center and in adjacent facilities, and to advise the area supervisor of pertinent information affecting the sector or adjacent sectors or facilities.

Finally, the radar controller is responsible to initiate the handoff of aircraft from one sector to another. This is done both manually and through the computers. From an operational standpoint, the boundaries between ARTCCs are no different from those between sectors. The transition is handled in the same way, with handoffs accomplished the same way.

International flights across the Atlantic are issued their oceanic clearance to their destination by the R controller in the last domestic ARTCC prior to entering oceanic airspace. Oceanic controllers utilize flight progress strips to maintain a mental picture of traffic. Some Atlantic- and Pacific area controllers use graphic depictions of aircraft position on the Oceanic Display and Planning System (ODAPS) displays. All altitude and route changes are relayed via a third party, Aeronautical Radio Incorporated (ARINC) on high frequency (HF) long range radios.

Flight Service Operations

Aircraft flying under VFR may operate without the services of air traffic control. On the other hand, the Flight Service System is in place to provide in- flight services to pilots not under the control of the ATC facilities. There are several functions of the Flight Service Station system to serve pilots operating under VFR.

The in-flight function delivers information and/or services to airborne aircraft as requested or as required when adverse weather conditions exist; relays air traffic control clearances to airborne VFR aircraft and to aircraft departing from non-controlled airports; monitors navigation aids in the station's flight plan area and reports abnormalities or outages to pilots when they occur; solicits pilot reports from aircraft operating in the area and passes the information on to other pilots and to ATC; and provides emergency services on a priority basis, when necessary.

The in-flight position receives input from pilots, from airport management, from ARTCCs and air traffic control towers, from automated NAVAID monitors, from adjacent facilities, and from specialists on other positions in the FSS. These include preflight, flight watch, and NOTAM positions

Requests for information from an in-flight specialist are received via two-way radio communications. The request may vary, from information regarding a single location, such as a NAVAID or an airport, to an entire weather update. In-flight weather briefings contain weather advisory information pertaining to an area within 150 miles of the requesting aircraft. NAVAIDS are monitored at the in-flight position with the use of cathode ray tube (CRT) monitors, which display the status of several NAVAIDS at a time.

Requests are handled on a first-come, first-served basis, with the exception of emergencies and search and rescue missions. Pilot reports may be solicited when conditions require, or when current conditions are not as forecast. Local airport advisory services are provided for non-towered airports and airports with part-tame towers.

Detailed real-time weather briefings are provided to en route aircraft by the FSS flight watch (FW) position. The person at this position is responsible for obtaining a complete briefing prior to coming on line at the position, becoming familiar with the most current information from the NWS and meteorological charts, all current NOTAMS, and active pilot reports. In addition, the flight watch specialist may obtain a briefing from the CWSU at the area ARTCC. During the course of the shift, the FW is constantly updating weather information through hourly weather reports and PIREPS obtained from aircraft contacted. The specific area of weather the FW is concerned with is en route weather. The kind of information FW provides includes current and forecast weather for intended and alternate airports of landing, and route and destination changes to avoid areas of weather that constitute a threat to safe operations.

The air traffic control system also provides emergency assistance to VFR operators when the need arises. Pilots occasionally lose track of where they are, and a system is in place to help them locate their position and complete their flight. Using Direction Finder (DF) receivers on the ground and the airborne radio communications system, air traffic controllers can identify an aircraft's position even when it is out of radar coverage. The controller then assists the pilot in establishing his/her position and provides guidance to their destination.

When an aircraft is overdue at its destination according to its filed flight plan, or when one is reported missing, the FSS initiates a process to determine if the flight was completed and the flight plan not closed, or if the aircraft is in trouble. Search and rescue activities are initiated if attempts to locate the aircraft are unable to determine that the flight was completed safely. All aircraft are required to carry an Emergency Locator Transmitter (ELT), which activates in a crash landing and transmits a steady used by Direction Finder equipment to locate the aircraft.

3.4 Users or Involved Personnel

In this section the focus is on the roles and responsibilities of each of the active participants in the present environment or situation that will be affected by changes to the NAS. Simply stated, all active participants will be affected by the needed changes. Users and involved personnel are identified in Table 1. This table is not in total agreement with the Appendix. This will be fixed in the next version of this OCD.

ATSP Roles and Responsibilities: The air traffic controller sends the following four types of messages to aircraft:

- Clearance. This is a required maneuver for separation, e.g., Cleared for takeoff
- ATC instruction. Similar to a clearance but more urgent, e.g., “go around”, “turn left to (new heading)”.
- Advisory. Provides a flight crew with awareness of traffic, weather, turbulence, etc.
- Traffic management directive. Informs flight crew of restricted airspace or RTA assignment.

Specific Roles and Responsibilities for each of the ATSP positions are presented as Appendix A. These descriptions have also been taken from Reference 16.

Pilot Roles and Responsibilities: The IFR aircraft pilot has responsibility for situation awareness flight planning/replanning and execution, and adherence to clearances/instructions issued by the ATSP.

AOC Roles and Responsibilities: The AOC dispatcher has the responsibility for scheduling company aircraft and for filing flight plans and amendments that are cooperatively developed with the pilot of the aircraft in question.

Table 1. Users/Involved Personnel for Current Operations

Users or Involved Personnel	Current Operations
Traffic Management Specialist at Air Traffic Control System Command Center (ATCSCC)	✓
Air Traffic Control Supervisor (ATCS)	✓
Supervisory Traffic Management Coordinator-in-Charge (STMCIC)	✓
Operations Supervisors (OS)	✓
Traffic Management Coordinator (TMC)	✓
En Route Radar Position – R controller	✓
En Route Radar Associate (RA) – D controller	✓
En Route Radar Coordinator (RC)	✓
En Route Radar Flight Data (FD) Position	✓
En Route Non Radar (NR) Position	✓
Terminal Radar Position – R controller	✓
Terminal Radar Associate (RA) – D controller	✓
Terminal Radar Coordinator (RC)	✓
Terminal Radar Flight Data (FD) Position	✓
Terminal Non Radar (NR) Position	✓
Tower Local Controller (LC)	✓
Tower Ground Controller (GC)	✓
Tower Associate	✓
Tower Coordinator	✓
Tower Flight Data Position	✓
Tower Clearance Delivery Position	✓
Flight Service Station Specialist (FSSS)	✓
Airline or Aircraft Flight Operations Center (AOC)	✓
Pilot or Flight Crew (FC)	✓

Flight crew and air traffic control actions are subject to traffic management action or initiatives, which are taken in response to sir traffic demand (and in excess of capacity) to direct aircraft to avoid severe weather. The ATCSCC transmits advisories to airline dispatch offices concerning the status of the national management initiatives. These initiatives in response to excess demand frequently utilize delay departure times to smooth the flow of traffic and to avoid costly airborne holding. Initiatives designed for severe weather avoidance usually results in a non-standard route of flight. Flight planning by the Airline Operations Center(AOC) dispatcher and crew take into account possible ground delays and non-standard routings.

3.5 Support Strategy

To be determined

4. Justification for and Nature of Change

4.1 Justification for Change

The latest version of the FAA's Operational Evolution Plan (Reference 6) states:

"The Operational Evolution Plan (OEP) is the Federal Aviation Administration's (FAA's) rolling ten-year plan to increase the capacity and efficiency of the National Airspace System (NAS) while enhancing safety and security. The commitments and decisions in the OEP have emerged from a close collaboration with the entire aviation community, including the airlines, cargo carriers, airports, manufacturers, general aviation, the Department of Defense (DOD), the National Weather Service, and the National Aeronautics and Space Administration, all with a focus on the air transportation services delivered to the flying public. The OEP represents the agreements and commitments of the FAA, DOD and the aviation community to modernize the NAS and solve problems in core areas, or quadrants: Arrival/Departure Rates, En Route Congestion, Airport Weather Conditions, and En Route Severe Weather.

The tragic events of September 11, along with a depressed U.S. economy have significantly impacted the airline industry. Overall, the number of airport operations during 2002 was about 10 percent below 2000 levels, and the number of en route operations during 2002 was about five percent lower than 2000 levels. While traffic has recovered more rapidly at Midwest airports than on the East and West coasts, airports that consistently demanded attention in the past continue to do so and as the economy improves, we fully expect that the demand for aviation services will increase to pre-September 11 levels. In fact, one aspect of the demand for aviation is already affecting operations; namely, airlines are continuing to increase usage of smaller aircraft, including regional jets, adding to already complex traffic flow management in many areas across the nation. For these reasons, we are staying the course to build an aviation system for the 21st century with efficiency and capacity improvements needed to meet the growing demand for air travel and cargo shipment. At the same time, we have taken into account the current economic climate by providing increased clarity about avionics requirements that build on existing equipage. Version 5.0 of the OEP captures commitments and investments across the aviation community and presents key accomplishments, activities and policy decisions that the community has reviewed and advocated through a process established by RTCA, the standards setting association for the aviation community."

*A 2001 report (*Reference 19) *from a joint committee of the FAA's Research, Engineering, and Development Advisory Committee and NASA's Aerospace Science and Technology Advisory Committee found that:*

"While upgrades to the current system may address some of these constraints in the 2000-2010 timeframe, none will enable the nation to meet its air transportation needs beyond this time. This is unacceptable."

"At best, existing Federal programs, such as the Free Flight Phase 1 and 2, are band-aids to a system that needs a major redesign." and

"In spite of growing demand and constrained supply, we believe that it is unlikely that the nation's current air traffic system will become totally gridlocked. The airlines and airports will adapt their behavior to ensure their economic viability, and the flying public will modify their demand for air travel as the convenience and cost of such travel changes. The result will be higher ticket prices, less convenience for the travelers, reduced growth in air commerce and, hence, a negative impact on the economy. This is unacceptable, especially when options exist to meet the demand while improving safety and security and reducing energy consumption and environmental impact of air travel."

4.2 Description of Needed Changes

Changes Identified in the OEP: As illustrated in Figure 1, the OEP is organized into four problem clusters, or quadrants:

Arrival/Departure Rates

- Coordinate for Efficient Surface Movement
- Fill Gaps in Arrival and Departure Streams
- Redesign Terminal Airspace and Routes
- Use Crossing Runway Procedures
- Build New Runways

En Route Congestion

- Accommodate User Preferred Routing
- Reduce Oceanic Separation
- Reduce Vertical Separation
- Reduce Voice Communications
- En Route Congestion Management
- Match Airspace Design to Demands

Airport Weather Conditions Airport Weather Conditions

- Maintain Optimum Runway Use
- Enhance All Weather Surface Operations
- Reconfigure Airports Efficiently
- Space Closer to Visual Standards
- Maintain Runway Use in Reduced Visibility

En Route Severe Weather En Route Severe Weather

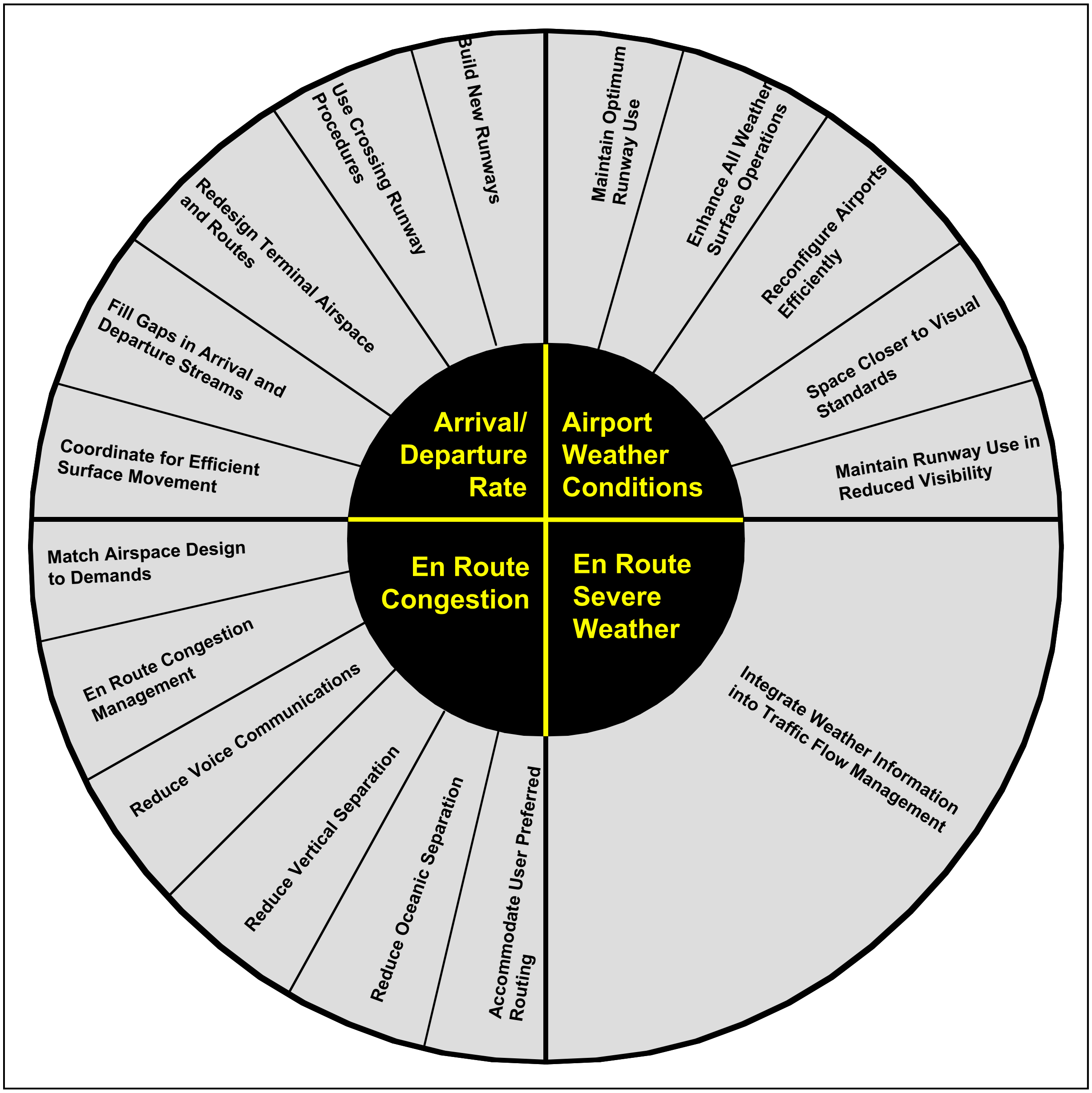
- Integrate Weather Information into Traffic Flow Management

Each quadrant is composed of solution sets representing commitments of the aviation community to operational changes that enhance efficiency and increase NAS capacity. Solutions sets also include benefits, schedules and key decisions.

The OEP represents the capacity and efficiency cornerstones of modernization. OEP commitments include changes in technology, airspace design, airport infrastructure and new or modified procedures for aircraft crew members, airline operations personnel, FAA controllers, traffic flow management specialists, and maintenance specialists. These commitments and decisions in the OEP emerged from and continue to require the coordination of all members of the aviation community, including the airlines, airports, manufacturers, general aviation, the Department of Defense (DoD), NASA, the FAA and the flying public.

FAA Capital Investment Plan (CIP) and National Aviation Research Plan (NARP): The FAA's CIP and NARP (References 7 and 8) identify major system investments and research and development which describe many of the projects and programs the FAA is undertaking to identify and implement needed changes to the NAS.

Figure 1. OEP Changes to the NAS



<u>**NASA Advanced Air Transportation Technologies Decision Support Tools:**</u> The primary objective of the AATT project is to fully explore the possibilities of the "Free Flight" concept. AATT products will enable substantial increases in the effectiveness of national and global air transportation systems. These increases will be achieved by developing and testing automation aids that can assist in the decision-making process among pilots, air traffic controllers, and dispatchers.

The AATT project (References 9 and 10) is responsible for defining, exploring, and developing advanced air traffic system concepts to a level suitable for pre-production prototype assessment by the FAA which, if successful, will result in full-scale deployment. These decision support tools will allow all airspace users to choose the best flight path for their own purpose within the constraints of safety and the needs of other users. To do this, several goals must be met: allow users to minimize operating costs by making trade-offs between time and routing; improve the effectiveness of high-density operations on the ground and in the air; enable safe operation in a smooth and efficient manner across boundaries of free-flight and capacity-constrained flight regions; provide system improvements that are easily deployable anywhere in the world; and improve the ability to simulate advanced capabilities in the airspace system.

The AATT project is developing computer-based analysis, prediction and display tools to aid air traffic controllers to manage aircraft. Continued development and enhancements to these tools are expected to occur through completion of the project in 2004.

OCDs for nine of the NASA AATT tools have been developed and are companions to this NAS OCD. These specific OCDs provide detailed descriptions of the tools that are being developed to address a subset of the future NAS capabilities described in Section 5.3. The AATT OCDs are:

- System Wide Evaluation and Planning Tool (SWEPT)
- Direct-To (D2)
- Expedite Departure Path (EDP)
- Multi-Center Traffic Management Advisor (TMA-MC)
- Surface Management System (SMS)
- Regional Metering (RM)
- DAG CE-5 En Route Free Maneuvering
- DAG CE-6 En Route Trajectory Negotiation
- DAG CE-11 Terminal Arrival: Self Spacing for Merging and In-Trail Separation

Other AATT tools, for which no OCDs have been developed at this time, that will provide additional future NAS capabilities include:

- Active Final Approach Spacing Tool (aFAST)
- Passive Final Approach Spacing Tool (pFAST)
- Collaborative Arrival Planner (CAP)
- En Route Descent Advisor (EDA)
- Surface Movement Advisor (SMA)
- Traffic Management Advisor (TMA)
- Autonomous Operations Planner (AOP)
- En Route Data Exchange (EDX)

Each of the above AATT tools is briefly described in Volume 2 of this OCD.

The AATT project will demonstrate the feasibility of decision support tools and airborne systems that will allow at least a 15 percent increase in throughput per runway at capacity constrained/multi-runway airports and a 20 percent increase in controller productivity. The project will also be conducting two major efforts to validate the benefits of these new technologies. The first effort will demonstrate and evaluate the use of advanced air transportation technologies (TMA-MC) for flexibility of operations in the congested region of the Northeast corridor of the US. The second effort will evaluate the feasibility of advanced air traffic management concepts with distributed tasks between flight crews and ground controllers (DAG CE-6, DAG CE-11) for safe air-to-air separation.

<u>NASA VAMS Concepts:</u> As part of the Virtual Airspace Modeling and Simulation (VAMS) Project's effort to research future air transportation system capacity-increasing concepts (CIC), NASA is exploring alternative revolutionary air transportation management (ATM) system operational concepts for the NAS of the future. The goal to produce a reasonable set of revolutionary but maturing capacity-increasing concepts that are successively blended into a single, beneficial, NAS system-level unified capacity-increasing concept. The objective is to complement NASA's in-house activities in identifying revolutionary capacity-increasing concepts, with potentially high payoff, worthy of further evaluation and deeper technical investigation. A further objective is to blend all of the operational concepts together into a single, beneficial, NAS system-level unified capacity-increasing concept. The set of concepts currently being explored are illustrated in Table 2.

Table 2. VAMS Concepts

4.3 Priorities Among the Changes

Organization	Concept Name	Domain
Boeing	Air Transportation System Capacity Increasing Concepts Research	Gate-to-Gate
Metron Aviation	Technologies Enabling All-Weather Maximum Capacity by 2020	Gate-to-Gate
Seagull Technologies	Concept PTP: Massive Point-To-Point and On-Demand Air Transportation	Gate-to-Gate
Northrup Grumman	Centralized Terminal Operation Control	Terminal
Metron Aviation	Capacity Improvement Through Automated Airport Surface Traffic Control	Surface
Optimal Synthesis	Surface Operation Automation Research (SOAR)	Surface
Raytheon	Terminal Area Capacity Enhancing Concept (TACEC)	Terminal
NASA – ARC	Advanced Airspace Concept	En Route
NASA – ARC	System-Wide Optimization	Gate-to-Gate
NASA – LaRC	Wake Vortex Avoidance Systems (WVAS)	Terminal
NASA – University Group	University Concepts	Gate-to-Gate

The FAA's OEP has top priority among the changes to the NAS identified above. There is no priority established among the remaining changes because of the early stage of development of these concepts.

4.4 Changes Considered But Not Included

There are no relevant changes to the NAS that have been considered but not included.

4.5 Assumptions and Constraints

The following assumptions and constraints apply to the future NAS.

Demand

- Today's pacing airports will remain as critical origins and destinations
- Cargo - There will be a large growth in air cargo
- Hub/spoke operations may disappear

Infrastructure

- Computational power will not be limiting factor
- CNS will be adequate or requirements identified as concepts are developed
- Communication bandwidth will be available
- Weather prediction may improve or may not improve
- There are significant capacity limits in current ATC

Aircraft characteristics

- Unmanned air vehicles use may increase
- STOL aircraft use may increase and use small airports, other sites, and underused airspace
- Significant increase in the use of runway-independent aircraft
- Increased commercial use of space transport

Fleet mix

- Bigger spread of aircraft size
    - Airplanes may get larger and smaller
- Large growth in
    - Air taxi
    - Fractionally owned jets
    - High performance small aircraft

Airports

- Major airports will tend to push out smaller aircraft
- Number capacity-constrained airports may increase
- There will be no new major airports or major expansions
- Increased percentage of passengers may embark/disembark from aircraft at other than today's gates
- Multiple use of military airports may evolve
- Change in roles of particular airports
    - Lower capacity commercial traffic migrates to smaller airports
- Cargo and airports

    - More airports with cargo operations
    - Dedicated cargo airports may exist
    - More airports with both passenger and cargo
- More all-weather airports

Airport connectivity

- High-speed multi-modal transportation may exist within a regional hub
- Mix of airports in a region
    - City hubs evolve into regional hubs

Agents

- Responsibility for safety will be redistributed among controllers and pilots
- Current roles and labor structure may change
    - For ATF/ATM;
    - For airlines
    - Categories may change for controllers and pilots

Policy

- Policies may be developed to maximize economic benefits from high density network
    - 1st come, 1st served may become less prevalent
    - Slot auctions may be used
- System will be designed and managed to maximize benefit to public
    - Various parts of system (e.g., airspace, airports, runways, etc.) will be viewed as national assets
    - Airport assets will be part of system, not necessarily operator owned
- Security concerns may
    - Change airport structures in unknown ways
    - Constrain air travel demand
    - Cause disruptions to air travel operations
    - Not be an issue as security may be resolved
- Military/security requirement may require all aircraft to be tracked
- Environmental constraints may significantly constrain
    - High-altitude flying
    - Airport operations

5. Concept for a New or Modified System

5.1 Background, Objectives, and Scope

The future NAS will differ dramatically from the current NAS. It will be characterized by:

New Technologies - New technologies in communication, surveillance, navigation, automation, and weather sensing will be provided via a phased technology implementation. These technologies includes seamless communications, fault-tolerant systems, and enhanced weather sensing and forecasting capabilities.

Improved Information - User and service provider situational awareness will be increased with a common situational picture among users and service providers. A NAS-wide information distribution system will greatly increase the collection, distribution, and use of useful information.

New Roles and Responsibilities - There will be redistributed roles and responsibilities for separation assurance. Collaborative decision-making will be the rule, supported by human centered decision support tools

New Airspace Structures and Rules - There will be a capability for dynamic airspace boundary adjustments. Structure routes will be eliminated. There will be reduced separation standards, and oceanic airspace will closely remember domestic airspace structures and rules.

Improved NAS Management -There will be an improved infrastructure/information management capability. NAS performance measurement, facility management, and operational supervision will be improved.

Ability to Handle New Vehicle Classes - The future NAS will have the ability to efficiently handle new vehicle classes: tilt rotor, UAV, ELV, and RLV.

5.2 Operational Policies and Constraints

The operational policies and constraints relevant to the present traffic management system are contained in References 7 and 8:

- FAA Order 7210.3S, Facility Operation and Administration
- FAA Order 7110.65N, Air Traffic Control

These operational policies and constraints will have to be modified to accommodate operations that are described in the following sections.

5.3 Description of the New or Modified System

5.3.1 System Capabilities Enhancement Area

The System Capabilities Enhancement Area is composed of three primary components: (1) enhancements to the NAS infrastructure; and (2) enhancements to the overall system capability that cannot be allocated to another Enhancement Area, which can include statements of overall economic, performance, or system requirements. The enhancements include enhanced surface, terminal, en route, and oceanic communication, navigation, and surveillance; improved weather systems; new service provider processors/displays and decision support tools; improved airport security and safety technologies; improved safety and security systems.

<u>System Capabilities Enhancement Area Operational Description</u>

Equipage - The future air traffic environment will provide flexibility and efficiency through development of a global airspace system incorporating the International Civil Aviation Organization's (ICAO) communication, navigation and surveillance (CNS) ATM concept. Some of the operational concepts rely on users to equip with advanced avionics technologies. It is important to state that not all users will be fully equipped in near term; the operational concepts merely reflect the capabilities available in the near term for those users that equip. It is clear that even though users may equip, not all will be similarly equipped. Indeed, varying levels of equipage will imply varying levels of service within the NAS. This is primarily because users make business decisions on equipage level based on their cost/benefit assessments. However, it is expected that every aircraft in the NAS will obtain some benefits regardless of their equipage level, with the level of benefits increasing as the level of equipage increases.

Widespread RNAV equipage and expanded surveillance coverage with new technology provide increased access to airports and airspace in poor weather conditions.

Most DoD aircraft are equipped with Global Air Traffic Management (GATM) enhancements. DoD aircraft that transit oceanic airspace have essentially the same characteristics as those described for civil users. Most of these aircraft fall into the military tanker/transport category. Those that do not are generally in formation with a tanker aircraft operating according to MARSA (Military Accepts Responsibility for Separation of Aircraft).

Testing - Before the operational concept moves from the concept stage to the implementation stage, the need exists for further development and validation of Free Flight and AATT technologies. Validation testing will serve to build a consensus among users, and between users and service providers. It is also of paramount importance that prior to operational implementation of any of the concepts described herein, required safety studies must be conducted, and joint government and industry agreement on certification criteria and standards must be established.

Human Centered Design - In the future NAS, a human-centered approach system design will assist in maximizing the efficient delivery of air traffic services to users. Thus, system processes and workstations will be designed to expedite the exchange of information between NAS information systems, service providers, and users. Integration of human factor principles, which are fundamental to the quality of ATM services, with staff planning and employment will allow for an increased service delivery. In addition, identification of changes to ATM job profiles as a result of new procedures and technology must be addressed. The coordination of the recruitment, selection, training, and licensing chain to maintain consistent high quality service will also be an important factor. Furthermore, there may be concerns about “cultural” issues regarding the introduction of new technologies (e.g., Decision Support Tools (DSTs)), procedures and roles/responsibilities, operational training and pilot/controller acceptance. For this reason, detailed consideration of social and motivating factors associated with transition, change and commitment will be required prior to implementation of the operational enhancements. Human factor analyses and human-in-the-loop simulations will be used to determine the appropriate allocation of tasks between service providers, users, and automation systems. Moreover, issues such as situation awareness, workload, and computer-human-interface (CHI) design will be resolved by incorporating human factors and operational assessments throughout the NAS enhancements design and validation process. Research activity will provide human factors information to conduct the necessary alternative evaluations, assess current and future affordability, contribute to the tradeoff analyses and investment decisions, and resolve cost-effectiveness issues during solution implementation.

Safety and Security - Evolution of the operational environment will be based on incremental implementation of new technologies. This approach maintains safety as the first priority, while also increasing capacity, efficiency, and flexibility in a balance with environmental considerations. NAS safety will be enhanced as new technology is introduced and system safety principles are applied in their design. The system safety process includes hazard analysis, risk assessment, risk mitigation, and risk management. The evolution of the NAS uses a clear transition strategy for each operational capability, and employs a human-centered approach for implementing new operational concepts and supporting technologies. This approach ensures that the human capabilities and limitations of users and service providers remain a primary consideration in systems development.

The NAS is a fault tolerant system, designed through safety and risk analysis to identify areas requiring higher reliability and backup. Since it is recognized that systems will fail, the design of the NAS enhancements will maintain a balance between reliability, redundancy and procedural backups. Thus the designs will provide a system which is not only more reliable but also requires minimal time to restore failed functionality.

Adequate backup and security procedures will be defined and described to address the failure and vulnerability of enabling technologies. An equivalent level of information security will match the growth in information exchange and collaboration. Security features are needed for the surveillance systems to ensure continued operations during events such as interference with WAAS correction signals; interference with GPS signals; and message flooding of the surveillance system, which is one of the reasons for continuing secondary surveillance radar (SSR).

Improved CNS capabilities in aircraft complement ground systems and reduce the impact of ground system failures while increasing system safety. This prevents either airborne or ground systems from bearing all failure risks and being burdened with the associated performance requirements.

System Wide Information System (SWIMS) - This system is also known as the NAS-Wide Information System (NAS-WIS). Information will be provided in a timely and consistent manner across the NAS for both user and service provider planning and decision making. An information system will serve as an avenue for a greater exchange of electronic data and information between users and service providers. A decision support tool will determine which data is important to each flight, so the appropriate information can be data linked to the flight. This information will be available through various verbal and electronic means.

A plan for creating and implementing the protocols and hardware for the SWIMS interface will be developed. This information system will enable decisions to be based on a shared common view of situations as conditions change. SWIMS information includes but is not limited to:

- Static data such as maps, charts, airport facility guides, and published Notices to Airmen
- Dynamic information such as current and forecast weather conditions, radar summaries, warnings of hazardous conditions, information on updated airport and airspace capacity constraints, and SUA schedules
- Flight information on each flight, such as: the filed flight profile and any amendments, the time of first movement of the aircraft, takeoff time, positional data in flight, touchdown time, gate or parking assignment, and engine shutdown time
- Schedule information that is updated throughout the day to reflect changes in carrier operations, including delays, cancellations, and prioritization of arrivals and departures
- Status of the NAS infrastructure, including facilities and equipment.

Communications - Mobile communications consists of networks that transmit voice and data among mobile users. These networks will interface with interfacility networks to provide communications paths between mobile users and users within a facility. Two types of mobile communications networks will be used in the NAS: air-to-ground and facility-to-facility communications networks that support ATC and ground-to-ground networks that support maintenance and administrative activities.

An integrated telecommunications infrastructure will interface with the AOCs and exchange both real-time and non-real-time information. The telecommunications infrastructure will provide real-time information exchange, electronic security, and non-real-time information sharing. Data standardization will address how data are exchanged between multiple applications.

Seamless communication and coordination, coupled with the SWIMS, will allow for the dynamic reassignment of airspace between facilities to meet contingencies such as equipment outages.

There will be increased collaboration among users and service providers. Collaboration includes information exchange plus shared and active user participation in decision making. For situations such as demand-capacity imbalances or severe weather, this capability supports determining when, where, and how transitional route structures are established in the airspace to meet a short-term problem. Collaboration also supports strategic problem resolution. All parties involved in collaboration will share a common situation awareness, using the best, most timely information possible.

Surveillance - Airborne and ground situation awareness will be enhanced by the availability of Automatic Dependent Surveillance (ADS). ADS-B (Broadcast) will enable positive control in non-radar environments. ADS-A (Addressable) is a different form of ADS, designed to support oceanic aeronautical operations, based on one-to-one communications between aircraft providing ADS information and a ground facility requiring receipt of ADS reports.

Automation, Data Collection, and Processing - Automation aids will enable the elimination of paper flight strips throughout the NAS. Aircraft progress will be tracked electronically with all critical functions provided for in the backup systems. There will also an increased usage of decision support systems that provide both information and heuristics to support the air traffic service providers (ATSPs) in their tasks. These tools will reduce the burden of routine tasks while increasing the service provider's ability to evaluate traffic situations and plan the appropriate response. This increased productivity is especially important given the potential for reduced vertical separation minima and increased traffic density. Automation systems will support the dynamic airspace structure with seamless inter- and intra-facility communication and coordination.

To support current flow management capabilities and planned enhancements, the TFM infrastructure will be upgraded to an open client-server infrastructure.

There will be improved methods for collecting and processing NAS infrastructure data. These data will be used to prioritize and schedule NAS infrastructure activities as collaboration between service providers and users. To facilitate this collaboration, decision support tools will include, where appropriate, information regarding the coverage and status of NAS infrastructure components. There will be improved methods and tools for measuring NAS performance with respect to user requirements, including the daily archiving of appropriate NAS user and service provider information. These improvements will be oriented toward providing the information in a meaningful and readily accessible format.

NAS infrastructure assets are assigned/reassigned dynamically to mitigate infrastructure problems as well as in response to changes in sectorization and airspace assignment. All NAS resources are registered in the Common Reference System, and monitored and managed through the SWIMS.

A common Geographical Information System (GIS) format is used to store all NAS information including terrain, obstacle, weather, and navigation, surveillance and communication coverage information. This information is available via the SWIMS to all service providers and users.

Airspace and Procedures - With the reduction of the computational and communications barriers of the present system, airspace design and underlying sector configurations will no longer constrained by the current geographic boundaries, particularly at high altitude. Tools and procedures will be in place for frequent evaluation (i.e., up to several times a day) of the airspace structure and anticipated traffic flows, with adjustments made accordingly. Due to this increased flexibility, the number and tasking of air traffic facilities may be modified to support dynamic traffic factors, rather than institutional requirements.

Operating procedures for service providers and users will accommodate the transition to Free Flight. Procedural changes will be developed, evaluated, and instituted to meet technology as it arrives, rather than post deployment.

Roles and responsibilities for separation assurance will shift from total ATSP responsibility to shared responsibility. In some special situations, the pilot of an appropriately equipped aircraft will be delegated responsibility for self-separation.

The operational supervisors will be key players in providing the flying public and aviation community the services they expect and deserve. They will provide the primary management presence in the operational area, enabling people and highly technical systems to collaborate in achieving desired outcomes and results. Managers will be provided with appropriate decision support systems to manage budgets, staff, and costs.

Using satellite-based navigation, cockpit display of traffic information (CDTI), and tower automation to detect impending traffic conflicts, airport operations continue at nearly visual rates in very low visibility conditions.

New Classes of Vehicles - UAVs continue to proliferate throughout the system and commercial use increases. SUA operations include newer uses such as commercial space launches and UAV operations.

New range automation technology is used to coordinate space vehicle flight profiles in support of launch and reentry activities. Shared access to all commercial space operations schedules is provided via the SWIMS.

Military space operations schedules are also available to selected service providers based on security requirements. This integrated set of schedules allows mission planners to synchronize their operations and mission support services. The schedules also provide the service provider with a global view of the projected demand generated from space operations.

Space vehicle flight profiles describe user needs and take into account flow conditions and constraints. The SWIMS enables domestic and international users and service providers to access flight profiles and associated SUA data.

Most space operations continue to be conducted in the traditional manner from coastal, federally operated ranges, but from an increasing number of spaceports at coastal, inland, sea-based, and island locations. They continue to have no impact on normal surface operations. New spaceports are in relatively remote locations that have minimal impact on existing airport operations. The types of vehicles accommodated at a given spaceport are determined by such factors as spaceport infrastructure, traffic impacts, noise abatement, hazard risks, launch and reentry concepts, payload processing, and fuel requirements (e.g., solid, liquid).

Space vehicles operate at dual-use facilities handling both aviation and space operations. Dedicated launch/reentry sites are established within high density terminal airspace. Space vehicles operate in accordance with the same surveillance and control techniques used for conventional aircraft. Space vehicle flight profiles are developed that accommodate user priorities while being sensitive to flow conditions and constraints. The SWIMS enables domestic and international users and service providers to access most space mission profiles and associated SUA data.

Space vehicle flight restrictions, due to traffic, are matched to the inherent constraints of the mission/vehicle. Departing and arriving space missions are time-constrained by strict launch and reentry windows, and are by factors such as feasible alternate landing facilities.

RLVs are developed and operate at various launch and reentry locations in the NAS. Some RLVs have operational characteristics similar to conventional aircraft and use dynamically defined route structures to facilitate transition to and from space. Depending on the mission and vehicle profile, these routes are used in conjunction with reserved airspace volumes to segregate different types of missions, to concurrently accommodate different mission phases (e.g., launches vs. re-entries), and to ensure safety in case of contingencies.

Oceanic airspace serves space vehicles operating from coastal, island, and sea-based launch facilities. Recovery operations are rare, and those that occur are bound for landing facilities at coastal ranges. Due to the lack of precise (i.e., radar-like) surveillance and direct communications in oceanic airspace, reserved airspace volumes are used almost exclusively to provide separation assurance for space vehicle operations. As radar-like surveillance and direct communications become available in oceanic airspace, space vehicles utilize the same general capabilities in oceanic airspace as used in the en route environment.

5.3.2 Flight Planning Enhancement Area

In order to satisfy future user requirements, the static and repetitive flight plan process currently used by service providers will be enhanced to provide a collaborative interaction with the user (i.e., pilot and AOC). This interaction will create dynamic, event-driven user-preferred trajectories for individual flights. This interactive flight planning information is also available to all General Aviation (GA) pilots. A Flight Planner Display will be available to both users and service providers to satisfy these flight-planning concepts.

The future flight planning process will be based upon the enhancement of the near-term systems capabilities resulting from the real time sharing of information regarding the NAS and system demand. Service providers will move to a collaborative interaction with the user, where both reveal strategies and constraints and mutually develop solutions to problems.

Flight Planning Enhancement Area Operational Description

User Preferred Routing - In the near term system, the flight plan routing on IFR flight plans is based on a system of low and high altitude airways that are generally straight line segments between ground based navigation facilities. Standard Instrument Departure (SID) and Standard Terminal Arrival Route (STAR) procedures, which are also based on ground based navigation facilities, connect the airports with the en route airway structure. Users with properly equipped aircraft will be soon be able to file user-preferred routes from departure airport SID to arrival airport STAR or from airport-to-airport. Aircraft equipped with “self-contained” navigation may file for user-selected waypoints independent of airways and navigational aids.

The user supplies the service provider with the flight profile that best meets their (the user) requirements. If possible, within the constraints of system demand and capacity, this action initiates the automatic creation of a flight plan that contains either the user’s preferred route of flight or a more detailed time-based flight trajectory. User flight planning systems incorporate flow management constraints to use when planning. By using a controlled time of arrival control concept, the role of compliance is shifted to the user so they may plan flights according to their unique operational requirements as well as business needs.

Airspace congestion management capabilities help the users manage their fleets in ways that are comparable to capabilities used to manage airport capacity imbalances. These capabilities include exchanging slots for the constrained area among company flights as well as improved collaborative rerouting around flow constrained areas down to the individual flight. Airport and airspace congestion is managed by an allocation of the constrained resources to the users based on scheduled demand.

Launch and recovery operations are more predictable, allowing service providers to exercise tighter coordination of user requests for system resources. Four-dimensional flight profiles replace surface to unlimited altitude reservations (ALTRVs) and commercial use of previous DoD planning resources.

More Information Available - In the future NAS there will be significant changes in the planning data available to all users, and in the flight plan itself. In today's planning process, the planner refers to a variety of sources for static information regarding terrain, airways and airports. The planner also utilizes dynamic information concerning weather, radar summaries, hazardous condition warnings, airport and airspace capacity constraints, SUA schedules, and the status of NAS infrastructure components. In the future, planners and service providers have automated access to this information from the continuously and automatically updated SWIMS. The scope of information will be expanded to include items such as: real-time information on the status of SUAs; real-time status of the NAS infrastructure; predictions of traffic density and delays based on the current flight trajectories, both filed and active; and current and planned dynamic route structure and associated transition points. Real-time trajectory updates reflect more realistic departure times, resulting in more accurate traffic load predictions, and increased flexibility due to the imposition of fewer restrictions.

All users can evaluate their planned flight against system constraints such as hazardous weather, SUA, traffic management flow restrictions, airspace facility demands, and infrastructure outages in advance of the flight. The advance knowledge of conditions along the proposed route allows the flight planner to anticipate possible reroutes that may be needed after departure. In the future, users will have the information, tools and an interactive capability necessary to create a flight profile that can be as simple as the user's preferred route or as detailed as a time-based trajectory including preferred climb and descent profiles.

For all users, an enhanced flight plan will be available that provides a much larger data set, including preferred trajectory, aircraft weight, runway preference for departure and arrival, gate assignment, and cross-border issues for international flights.

The information within this flight profile can be updated throughout the flight, providing a common source of information to users and service providers. As the flight profile gets generated, information on current and predicted weather conditions, traffic density, restrictions, and status of SUAs will be available to assist the planning. When the profile is filed, it will be automatically checked against these conditions and other constraints, such as terrain and infrastructure outage advisories. The operational reasons for requesting modifications or rejecting the flight profile will be transmitted to the planner. After approval, the profile will be automatically distributed to service providers who will monitor the flight. Elements of the SWIMS are used to obtain and distribute flight-specific data and aeronautical information, including international coordination of flight trajectory content. Standardized domestic and international trajectory information improves the interaction between the NAS, NAS users, and domestic and international service providers.

More current airport information being available. Most airport information is generated by official service providers (e.g., FAA, National Weather Service (NWS)). However, unofficial information at remote airports can be received from private users/observers at those locations. This information is recorded in automation (and clearly flagged as 'unofficial information') for use and distribution by the advisor.

In the future, GA user has the capability to access the same flight data used by all other system users and service providers via personal computer, personal digital assistant, fixed base operator (FBO), or service provider computer. Those users connecting through personal computer are able to enter a command and be transferred to a service provider for clarification of the information. Depending on the user's equipment, this dialog can be by voice or through electronic messaging. VFR flight plans, once filed, are available to all ATSP. At airports where data link is available through the services of a FBO, the data link information is available to GA users who are data link equipped.

In the future, air traffic service providers will maintain a continuously updated database of airspace and flow restrictions. The AOC and ATC computers will share this information. The AOC flight planner will prepare a proposed flight plan, performing a probe for active or scheduled SUAs, weather, and airspace and flow restrictions. The AOC flight planner will use this information to file the final flight plan.

Interactive Flight Planning Aids - In the future, interactive flight planning aids will be available for pilots of properly equipped aircraft to aid in filing airport-to-airport flight plans with user-preferred routings for domestic and international flights. Interactive aids facilitate a more collaborative role for users in obtaining NAS information in order to improve their ability to execute the flight plan. Examples of this information include current and predicted status of SUAs, infrastructure status, traffic density, and prevailing traffic flow initiatives. Interactive flight planning allows the AOC to better monitor fleet activities during routine and non-routine operations, which results in better resource utilization and cost savings.

Presently, DoD flights originating from a military airfield generally have access to a military weather briefer and self-brief on system information from the NOTAM listings. Some Military Base Operations facilities provide computerized flight plans which take into consideration known winds and aircraft performance characteristics. International flights are filed on a standard International Civil Aviation Organization (ICAO) flight plan. Military flights originating from civil fields usually follow the same procedures as GA flights. It is worth noting that for national security reasons, a secure encryption capability exists to protect DoD information as required. In the future, the DoD user will have real-time interactive flight planning capabilities, which enable more effective flight planning with respect to NAS resources.

During the flight planning phase, airlines with AOCs and GA with AOC-like capabilities will be able to file ICAO-formatted Filed Flight Plans (FPL) using the en route automation system for flights operating domestically and regionally, e.g., in Canadian and Mexican airspace.

Since the ICAO format contains a 4D profile, it provides potential benefits for use in a Free Flight environment. As conditions change during the planning phase or during the flight, the user will be able to interactively determine the impact of the changes on the flight and modify the flight plan as necessary. The status of active and proposed flights, as well as real-time updates to reflect more realistic departure times (e.g., the latest planned departure times) will be available to NAS users. This will result in more accurate predictions of traffic load, and increased flexibility due to the imposition of fewer restrictions. Current information will also available on the status of the NAS infrastructure. Availability of flight planning information and NAS infrastructure information will facilitates more effective collaborative decision making between the AOC and the ATSP. This increased collaboration and information exchange between the user and the service provider will provide a baseline of planning for traffic loading.

New Flight Object - As a result of these improved planning capabilities, today's flight plan will be replaced by a flight object. The flight profile information contained in the flight object can be as simple as the user's preferred path, or as detailed as a time-based trajectory that includes the user's preferred path and preferred climb and descent profiles. The flight profile can include parabolic flight profiles. The flight planner will interact with the SWIMS to create a flight profile. This action initiates the automatic generation of a flight object containing either the users preferred flight path or a more detailed time-based flight trajectory.

For an appropriately equipped aircraft operating under VFR, the flight object contains the flight path, a discrete identification code that provides precise location and identity information, and all necessary information to initiate search and rescue. For a flight operating under IFR, the flight object can be a much larger data set, including a preferred trajectory coordinated individually by the user, and supplemental information such as the aircraft's current weight, position, runway preference, or gate assignment. The user or service provider throughout the flight can update flight object information. GA users are able to probe flight plans against system constraints. Navigation and terrain database services are available from which to update the databases used in the cockpit or hand-held avionics. As conditions change during the planning phase, or during the flight, the planner will continue to access the SWIMS to determine the impact of the changes on the flight. This information will be electronically available to all service providers until the termination of the flight. Information such as runway preferences and aircraft weight, or information to support flight following can be added during pre-flight or in-flight planning.

As the planner interactively generates the flight profile, information regarding current and predicted weather conditions, traffic density, restrictions and status of SUAs will be available to improve the efficiency of the task. When the profile is filed, it will automatically be checked against these conditions and any static constraints such as terrain and infrastructure advisories. Potential problems will automatically be displayed to the planner for reconciliation. Upon filing, the flight object will be updated as necessary, along with all affected projections of NAS demand. The flight object data set will be available throughout the duration of the flight, both to the user and to service providers across the NAS. Another tool that will assist in flight planning will be a decision support tool that will reroute calls from busy Automated Flight Service Stations to facilities with shorter waiting times.

For airborne flights, new profiles that do not require a tactical change to trajectory are processed automatically and included into the system. Other flight profiles are automatically distributed to the service provider and to the pilot as trial plans that are implemented when clear of near term conflicts.

5.3.3 Separation Assurance Enhancement Area

In order to satisfy future user requirements, the separation assurance service provided by the FAA will be enhanced to provide a self-separation capability by the users. While separation assurance will remain the responsibility of the ATSP, the ATSP may delegate this responsibility to the pilot in certain situations and under certain conditions. Decision support tools will aid both the pilot and the controller in assuring separation of aircraft from aircraft, aircraft from airspace, aircraft from terrain and obstacles, and aircraft from weather. Service providers will move to a collaborative interaction with the user.

<u>Separation Assurance Enhancement Operational Description</u>

For future requirements to be satisfied, separation assurance services must be enhanced. To assist with the evolution of Free Flight, separation assurance is enhanced through the use of improved weather radars, advanced conflict detection and prediction systems, new avionics such as ADS-B, CDTI, and Ground Proximity Warning Systems (GPWS), and the implementation of decision support tools both on-board the aircraft and in the ATC automation system. Improved situation awareness in the cockpit, enabled by these new technologies, allows some separation tasks to be performed by the flight crew. Aircraft not equipped to operate in a Free Flight environment will be handled as they are today.

The following paragraphs provide a description of the enhancements to the separation assurance on the airport surface, in the terminal area, in en route airspace, and over the oceans.

Airport Surface - A surface management information system will enhance separation assurance on the airport surface by providing access to airborne and surface surveillance information, flight information and pilot reports, and weather information, including current weather maps

As an aircraft prepares to taxi, service providers will use decision support systems to determine taxi sequencing (based largely on user preference), and to perform conformance monitoring and conflict checking. Improved knowledge of aircraft intent allows automatic monitoring of taxi plan execution and provides alerts to the potential for runway incursion. At some airports today, tower automation performs surface conflict detection; in the near future, enhancements will be made to this automation that take advantage of the improved accuracy of satellite-based navigation and surveillance. Aircraft using ADS-B on the airport surface will be subject to conflict detection checking by tower automation. This form of automation detects conflicts between aircraft as well as between aircraft and vehicles and performs conformance monitoring of the aircraft's taxi route to ensure that aircraft do not enter active runways without clearance.

While the ATSP continues to monitor aircraft movement and possible conflicts, pilots continue to rely on visual means for separation assurance. Pilot familiarity with the airport is enhanced with a moving map display that leads to better planning and increased safety during surface operations. Cockpit capabilities for some users include appropriate conflict detection logic, which, in conjunction with an airport moving map display to monitor present position, allows for safer operations, especially in low-visibility conditions. CDTI is available on some flight decks providing a display of the location of other equipped aircraft and vehicles on the surface. This gives the flight crew decision support information to better evaluate the potential for runway/taxiway incursions and ramp incidents, especially at night and in low visibility conditions. It should be noted that this information is of limited use unless a majority of traffic can be displayed in the cockpit of an equipped aircraft on an appropriate airport overlay map. The future state for airline airport surface movement potentially includes the capability for very low visibility or "blind taxi." Properly-equipped aircraft with specially trained flight crews will be authorized to taxi and provide their own separation assurance solely based on electronic means (e.g., enhanced vision moving map, CDTI, conflict detection logic).

Terminal Area - When appropriate, the ATSP will clear properly equipped aircraft to self-separate and maintain sequence. Appropriately equipped aircraft are given authority to select departure path and climb profile in real time, along with the responsibility to ensure separation from local traffic. Automatic dependent surveillance is used to enhance traffic awareness and traffic location accuracy in the cockpit.

The ATSP will approve or deny proposed flight plan changes, except those needed for cockpit self-separation when that responsibility has been transferred to the flight deck. As necessary for user self-separation, the locations of obstructions in and around some airports will be marked with ADS-B transmitters. During near-surface operations and with the flexibility of the new procedures, there is still the ever-present potential for controller flight into terrain (CFIT).

The potential for CFIT is significantly reduced for aircraft equipped with an Enhanced Ground Proximity Warning System (EGPWS) (based on GPS-derived position compared with a stored terrain database) which allows the pilot to more readily monitor terrain clearance.

Separation assurance in the terminal area is similar to the airport surface. Free maneuvering operations in low-density areas will be performed. High-density areas will still require the oversight from ATC for sequencing and primary separation assurance; however, even in the denser environments some cockpit self-separation will be assigned to the flight crew by ATC when operationally advantageous. A common understanding of significant weather will be shared by user and service provider, thereby enhancing safety and supporting collaborative decision making and self-separation. In order to make these capabilities a reality, widespread integration of weather data into automation and the SWIMS is necessary.

Future terminal operations will be characterized by the use of decision support systems that include improved capabilities for conflict alert, conflict detection and resolution, the inclusion of the flight deck in some separation responsibilities, and greatly enhanced weather detection and reporting capabilities. The future decision support systems will help service providers to maintain situation awareness, identify and resolve conflicts, and sequence and space arrival traffic. As a result, separation assurance in the terminal area will undergo changes in the following areas: aircraft-to-aircraft separation, aircraft-to-airspace and aircraft-to-terrain/obstruction separation.

Aircraft-to-aircraft separation will remain the responsibility of service providers, and, in most traffic situations, will remain solely their responsibility. Today's practice of visual separation by pilots in terminal areas will be expanded to allow all-weather self-separation when deemed appropriate by the ATSP. Satellite-based position data, broadcast by properly equipped aircraft, will be used in cockpit traffic displays to increase the pilots' situation awareness for aircraft-to-aircraft separation. These avionics allow an increasingly frequent transfer of responsibility for separation assurance to the flight deck for some types of operations. Approach and departure visual separation spacing will be more accurately maintained/judged by the pilot. Flight crews determine the distance between aircraft on the traffic display and relay that information to ATC. Air traffic controllers apply separation procedures, including Mach technique, to enable trailing aircraft to climb to the altitude of the lead aircraft and remain longitudinally separated. The rules, procedures, and training for these types of shared separation assurance remain to be defined. This separation assurance concept must account for potential on-board navigational failure in order to maintain a robust operational system. In addition, provisions must be made to ensure that equipped aircraft have a complete picture of all surrounding traffic in the terminal area, including unequipped aircraft or aircraft with an equipment failure.

To assure aircraft-to-aircraft separation, the ATSP will also use improved tools and displays. Today's situation displays and conflict alert functions will evolve to provide more information, based on expanded data acquisition and processing capabilities. Improved trajectory models and analyses benefit the service provider through highly accurate conflict detection functions and reliable conflict resolutions that maximize safety while minimizing traffic disruption. The addition of enhanced collision avoidance logic based on satellite-based navigation and surveillance information will improve collision avoidance capabilities. These conflict detection, resolution, and collision avoidance functions will consider arrival and departure traffic throughout terminal airspace, separation at the intersection of converging runways, separation between parallel runways, and separation from ground vehicular traffic on the runways. Specific parallel approach collision avoidance and escape guidance logic will permit the implementation of paired (dependent) and simultaneous (independent) approaches to closely spaced runways in Instrument Meteorological Conditions (IMC). This capability will also be enabled by the improvement of real-time wake turbulence visualization in the cockpit. Adequate CDTI and collision avoidance protection enhances safety during the reduction of the 250-knot speed restriction.

Aircraft-to-airspace and aircraft-to-terrain separation will remain the service provider's responsibility . The ATSP maintains separation between controlled aircraft and active SUAs, and between controlled aircraft and terrain/obstructions. An enhanced safe-altitude warning function enables the ATSP to keep aircraft safely above terrain and obstructions. For airspace separation, accurate information on SUA status and planned usage is disseminated automatically to the service provider through the SWIMS. In addition to airspace and terrain/obstruction avoidance, the service provider has improved tools to assist pilots in avoiding hazardous weather. Enhanced weather data and weather alerts are output on service provider displays, and simultaneously uplinked for display on the flight deck. These displays improve the service provider's ability to coordinate with the flight deck and with other service providers to ensure the avoidance of hazardous weather. Some users equipped with multi-function cockpit displays will have an enhanced ability to avoid hazardous airspace and terrain. Some DoD aircraft are configured with a collision avoidance system, along with cockpit displays of weather, which increase aircrew situation awareness.

En Route Airspace - Separation assurance will also be enhanced in the en route airspace. En route surveillance will be accomplished through a combination of primary radar, beacon interrogation, and broadcasts of aircraft position and speed. As more forms of position data become available, more traffic will be under some form of surveillance. One goal for future en route operations is to have new displays operational in all en route facilities allowing the service provider to have access to more accurate forecasts of potential conflicts. Decision support systems such as the conflict probe will assist the ATSP in developing safe and effective traffic solutions. Improving the service provider's ability to identify future conflicts will reduce the number of potential interventions and allow the user to fly the preferred trajectory with fewer diversions. Cockpit decision support systems will assist in conflict detection and in the development of conflict. The use of moving maps for CFIT avoidance, CDTI, and weather depiction will begin.

Improved decision support tools for conflict detection, resolution, and flow management will allow increased accommodation of user-preferred trajectories, schedules, and flight sequences. The use of satellite-based navigation and surveillance data will not only increase on-board capabilities ranging from cockpit traffic and enhanced collision avoidance logic, but will also be used by ground-system automation for enhanced conflict probe and alerting.

As in the departure and arrival operations, increased decision support allows significant improvement in en route separation assurance. Changes will be seen in both aircraft-to-aircraft separation and in aircraft-to-airspace separation. In a related area, there will be improved coordination between the service provider and the flight deck to aid the flight in weather avoidance. By using the improved information available from common weather sources, service providers will be more effective in controlling aircraft in airspace that contains hazardous weather and in providing weather advisories to pilots.

The ATSP will continue to issue control instructions to aircraft in order to maintain separation, but primarily in high-density airspace. Use of the ground based conflict probe will be modified to allow for airborne procedures to resolve most conflicts, thus allowing maximum routing flexibility with the least restrictions. Decision support systems will assist in conflict detection and the development of conflict resolutions. This reduces mental workload and gives the ATSP more time for other tasks such as responding to user requests. Improving the ATSP's ability to identify conflicts also reduces the number of occasions when there is intervention required, thus allowing the user to fly the proposed trajectory with higher frequency. Airlines and high-end GA will frequently perform free maneuvering operations in low-density areas and assume responsibility for separation. High-density areas will still require the oversight from ATC for sequencing and primary separation assurance; however, in some high-density environments, some cockpit self-separation will be assigned to the flight crew by ATC when operationally advantageous.

Service providers will continue to be responsible for maintaining separation between aircraft and certain types of airspace (specifically, active special use and adjacent controlled airspace), terrain, and obstructions. The activation of a SUA results in the re-evaluation of all flight trajectories in the SWIMS, to determine which flights will penetrate the SUA. This will result in earlier intervention and negotiation of new trajectories or airspace solutions. When flights are in close proximity to the newly activated SUA, the provider will use aircraft-to-aircraft conflict detection tools as aids to prevent them from entering the restricted airspace. Both earlier intervention and the closer-proximity resolution activities result in more efficient routing of aircraft.

Oceanic Environment - The greatest percentage of increase in air traffic is projected to occur across the Atlantic and Pacific Oceans. Improvements in CNS and weather detection are paramount enablers of oceanic capacity enhancements. In the future oceanic environment, integration of satellite-based surveillance and enhanced weather information into oceanic automation systems will provide improved separation assurance services. The ATSP will use visual displays to monitor and decision support tools to control the traffic situation.

Changes in both aircraft-to-aircraft and aircraft-to-airspace separation assurance will occur in the near future. More precise monitoring of separation and flight progression will be accomplished through automatic dependent surveillance The oceanic service provider will have a display of traffic in the oceanic airspace, ensuring separation in the same manner as in domestic airspace, although the separation criteria may be different.

Oceanic separation standards and procedures will be derived from radar control techniques. Real time position data and continuously updated trajectory projections will virtually eliminate manual control procedures in oceanic airspace. The oceanic service provider will benefit from use of the same type of decision support tools available to help en route service providers. Such tools aid in detecting and resolving possible conflicts, and preventing controlled aircraft from entering restricted airspace. Aircraft position updates are supplied by the aircraft's broadcast of satellite navigation-derived position data transmissions.

The oceanic environment creates opportunity for the transfer of separation assurance to the pilot for specific operations. Pilots will have situation awareness of nearby traffic through a CDTI and will use this information to enhance oceanic operations. Pilots may coordinate with service providers for clearance to conduct specified cockpit self-separation maneuvers while the pilot's view of nearby traffic supplements the service provider's big picture of longer-term traffic flow. When operationally advantageous, pilots may obtain approval for special maneuvers such as reduced separation in-trail climb, in-trail descent, lead climb, lead descent, limited duration station-keeping as well as lateral passing maneuvers. Oceanic aircraft will be permitted to laterally pass other aircraft at the same altitude by establishing an aircraft offset track and using self-separation. The pilot's ability to support climbs, descents, crossing and merging routes is supplemented by the service provider's conflict probe decision support system. ATC oversight is still required for sequencing and separation assurance, but collaborative decision making has greatly increased among the service provider, AOC, and the aircraft. This tighter cockpit self-separation decision/control loop could allow greatly reduced separation standards.

Oceanic airspace serves space vehicles operating from coastal, island, and sea-based launch facilities. Recovery operations are rare, and those that occur are bound for landing facilities at coastal ranges. Due to the lack of precise (i.e., radar-like) surveillance and direct communications in oceanic airspace, reserved airspace volumes are used almost exclusively to provide separation assurance for space vehicle operations.

UAV/ELV/RLV Operations - The majority of launches occur from U.S. launch bases and ranges. The FAA provides traffic management and separation assurance to vehicles as they transition through the NAS to and from space. ELVs and RLVs utilize airspace volumes that are dynamically reserved and released to allow the vehicles to transition through the NAS from sites other than the federal launch bases and ranges. The reserved airspace volumes are selected based on performance characteristics of the vehicle and overall safety considerations. The airspace volumes are tailored as mission needs or NAS needs dictate, in order to provide more flexibility than today's SUA.

5.3.4 Situational Awareness and Advisory Enhancement Area

Enhanced situational awareness and advisory is an essential element of the Free Flight concept embodied in most operational concepts. The future situational awareness and advisory services will be based upon the enhancement of the near-term system capabilities resulting from the real-time sharing of information regarding the NAS, traffic, weather, and system demand.

Situational Awareness and Advisory Enhancement Operational Description

For future requirements to be satisfied, pilot and controller situational awareness and advisory services must be enhanced. These services will be enhanced through the use of improved weather radars, advanced conflict detection and prediction systems, data link, new avionics such as ADS-B and multi-function displays, and the implementation of decision support tools both on-board the aircraft and in the ATC automation system. Traffic information collected by traditional ground-based surveillance systems is transmitted to aircraft. Enhanced weather information will be available for service providers and users. This includes automatic, simultaneous broadcast of hazardous weather alerts for wind shear, microbursts, gust fronts, and areas of precipitation, icing, and low visibility. Provision of real-time, in-flight winds and temperatures aloft to the ATSP will result in better weather information for forecasting and traffic planning. Combining 4D weather forecasts with aircraft trajectory predictions will permit a determination of those flights that will be affected.

The following paragraphs provide a description of the enhancements to situational awareness and advisories on the airport surface, in the terminal area, in en route airspace, and over the oceans.

Airport Surface - Surface movement is both the first and last step in the progress of a flight through the NAS. With little expected increase in the number of available runways or taxiways, the goal of the service provider is to remove system constraints on flights moving from pushback to the runway, and from the runway to the gate. Airport safety and efficiency is enhanced by terminal weather radar, automated weather observation systems, integrated systems to detect and predict hazardous weather, and improved surface detection equipment. For low visibility and zero visibility operations, participating aircraft are equipped with a visual meteorological conditions (VMC) - like capability to maneuver on the surface. Automation to monitor and predict the movement of ground vehicles provides further safety enhancements through improved conflict advisories. As the aircraft prepares to taxi, service providers use decision support systems to determine taxi sequencing (based largely on user preference), and to perform conformance monitoring and conflict checking. Since this automated planning process shares information with the surface situation monitoring systems, the resulting taxi plan balances the efficiency of the movement with the probability it can be executed without change. Improved knowledge of aircraft intent allows automatic monitoring of taxi plan execution and provides alerts to the potential for runway incursion.

Airport Surface Detection Equipment will be used for purposes of detecting non-ADS-B traffic and will reinforce ADS-B targets. With identification, position, speed, and heading of all surface traffic (i.e., aircraft and vehicles), the local and ground controllers in the tower will be able to monitor the movement of all traffic in the airport movement area traffic relative to the airport configuration. Satellite-based navigation, enhanced with the addition of Local Area Augmentation System (LAAS), provides more accurate position information on all aircraft and vehicles operating on the airport surface. GA users will have improved versions of the hand-held or panel-mounted GPS navigation equipment in use today. These devices have the potential for improving user situation awareness on ramps, taxiways, and runways through the use of moving map displays of the airport surface environment.

Airport surveillance will be enhanced with the advent of satellite-based surveillance broadcasts (e.g., ADS-B). This allows for low-cost cockpit traffic displays, thus enhancing the pilot's perspective of surrounding surface traffic. This gives the flight crew decision support information to better evaluate the potential for runway/taxiway incursions and ramp incidents, especially at night and in low visibility conditions. It should be noted that this information is of limited use unless a majority of traffic can be displayed in the cockpit of an equipped aircraft on an appropriate airport overlay map. A moving map display of the aircraft's position on the airport surface will increase pilot awareness of the situation and enhance safety. With accurate position information (e.g., taxi routes), a cockpit moving map with aircraft positions, and real-time data link information, airport operations can occur at near normal visual rates in near zero visibility conditions. Aircraft using ADS-B on the airport surface will be subject to conflict detection checking by tower automation. Tower automation detects conflicts between aircraft as well as between aircraft and vehicles. Tower automation also performs conformance monitoring of the aircraft's taxi route to ensure that aircraft do not enter active runways without clearance.

Visual observation that service providers currently rely upon is augmented with enhanced situation displays and surface detection equipment to improve situation awareness. In addition, service providers can display satellite-derived position data transmitted by selected flights upon request, while ground-based surveillance data is shared with users as a safety enhancement for preventing incursions. Situation displays are available for airborne and surface traffic, with appropriate overlaps for viewing arriving and departing traffic. The surface situation displays depict the airport and nearby airspace, with data tags for all flights and vehicles, resulting in safer, more efficient operations in low visibility. New traffic situation displays will allow ground vehicle operators to maintain situational awareness of all moving aircraft and vehicle traffic in their areas. This will help ground vehicle operators avoid conflicts with aircraft. Ramp service providers (either FAA or airline personnel) manage the movement of aircraft across ramp areas to the gates. Where used, they sequence and meter aircraft movement at gates and on ramps, using situation displays that interface with decision support systems and personnel in the control tower. Safety is enhanced by these situation displays which include airborne and surface traffic as well as information from the surface management information system.

Aeronautical information, such as NOTAMs and meteorological information for the airport vicinity, continue to be acquired by service providers and disseminated to users to aid in their planning and conduct of flight operations. However, acquisition and dissemination is expedited by the SWIMS. The ATIS information remains similar to the system of today but will use data link for delivery. In addition to data linked ATIS, clearance delivery, and taxi instructions, basic meteorological information, such as current and forecast weather and PIREPs, will be available in the cockpit, along with current weather maps. Pilots will receive weather information over data link for display inside the cockpit. These displays will be available for both user and service provider, with automatic, simultaneous broadcast of hazardous weather alerts to each. Weather information includes current observations, pilot reports, hazardous phenomena in both graphic and text format, and winds aloft information. ATIS information, weather information and clearance delivery in the cockpit via data link and synthetic voice will reduce frequency congestion and miscommunication of the spoken word. Real time updates of ATIS message components will be data linked to the pilot. These message components include RVR, braking action and surface condition reports, current precipitation, runway availability, and wake turbulence and wind shear advisories.

Terminal Area - Enhancements to situation awareness and advisory services are also provided in the terminal environment. With the introduction of a global standard for satellite-based navigation and surveillance, aircraft position is broadcast to ATC and other users to provide a common traffic picture to pilots and ATC service providers. The introduction of ADS-B combined with CDTI increases the level of pilot situation awareness in properly equipped aircraft. This concept must account for potential navigational failure in order to maintain a robust operational system. In addition, provisions must be made to ensure that equipped aircraft have a complete picture of all surrounding traffic in the terminal area, including unequipped aircraft or aircraft with an equipment failure. The improved information presented to the pilot allows for more accurate assessment of air traffic location and closure rates as well as improved wake vortex separation. With the capability for the flight crew to see the surrounding aircraft, modifications to service provider air traffic management procedures, and the improvements in turbulence and wake vortex avoidance, reduced or time-based separation standards can be implemented and more direct routes through the terminal airspace will be available. The ADS-B combined with the CDTI allows the continuation of visual approaches and departures even with momentary loss of visual acquisition as long as the other traffic is still displayed.

DoD users are equipped with augmented satellite-based navigation aids, data link, GPWS, cockpit display of traffic and weather information and on-board collision avoidance which increase aircrew situation awareness during the arrival and departure phases of flight. Other users are equipped with cockpit-based terrain and airspace displays that enhance their ability to avoid hazardous airspace and terrain. Terrain data base updates, which include man-made obstacles in addition to terrain maps, will be available to properly equipped users. Increased use of distributed responsibility is made feasible through improved traffic displays on the flight deck, combined with appropriate rules, procedures, and training to support the new roles and responsibilities of the users and service providers.

Data link and cockpit displays permit pilots of properly equipped aircraft to monitor all the surrounding traffic and to receive meteorological data, real time weather information and maps, and automated hazardous weather alerts in addition to the more routine message traffic in the cockpit. Properly equipped arriving and departing aircraft can receive expanded airport information through data link for display in the cockpit. Airport information includes RVR, braking action and surface condition reports, runway availability as well as wake turbulence and wind shear advisories.

Enhanced ATSP situation displays and conflict alert functions provide more information, based on expanded data acquisition and processing capabilities and improved trajectory modeling and analysis. Data acquisition from the flight deck, airline operations center, service provider, and interfacing NAS systems is improved. These inputs provide more information concerning traffic status and predictions, status of individual flights, pilot intent, user preferences, and traffic plans generated by upstream and downstream automation systems. With the improved accuracy and display of the weather information on the service provider’s display, a common understanding of significant weather will be shared by user and provider. Improved weather data and displays minimize disruption in departure and arrival traffic.

Available to both service providers and users, these data and displays enhance safety and efficiency by disclosing weather severity and location. Enhanced weather data and weather alerts are output on service provider displays, and simultaneously uplinked for display on the flight deck. These displays improve the service provider's ability to coordinate with the flight deck and with other service providers to ensure the avoidance of hazardous weather. Decision support systems will help service providers to maintain situation awareness, identify and resolve conflicts, and sequence and space arrival traffic. Improved service provider automation and displays and the use of cockpit situation displays enhance traffic situational awareness and allow for enhanced approaches and departures.

Automatic exchange of information between flight deck and ground-based decision support systems will improve the accuracy and coordination of arrival trajectories. This exchange includes the flight deck's wind and weather information, which is shared with the service provider and other flight decks.

Increasingly accurate weather displays will be available to service providers. In addition, automatic broadcast of hazardous weather alerts for wind sheer, microbursts, gust fronts, will be delivered simultaneously to the flight deck and service provider.

Shared access to the SWIMS will allow an automated exchange of gate and runway preference data between the flight deck, the airline operations center, and the flight object.

Status information concerning the NAS infrastructure components that support arrival and departure operations is shared with the flight deck.

En Route Airspace - En route surveillance will be accomplished through a combination of primary radar, beacon interrogation, and broadcasts of aircraft position and speed. As more forms of position data become available, more traffic is under some form of surveillance. An increasing number of aircraft are equipped with satellite-based navigation, digital communications, and the capability to automatically transmit position data. Many of these aircraft have this capability coupled to an FMS. FMS equipage, including coupled navigation capabilities, also allows for more efficient flight planning by the AOC. Additional intent and aircraft performance data is provided to decision support systems, thus improving the accuracy of trajectory predictions. This information is combined and presented on the service provider's display. To assist with situation awareness and advisory in the en route environment, new ATSP displays will be operational in all en route facilities and the service provider has access to more accurate forecasts of potential conflicts. Since there are different separation standards depending on the flight's equipage and the quality of the positional data, service provider displays indicate the quality of the resulting aircraft positions and the appropriate equipage information.

The availability of flight data for all flights via the SWIMS improves the ability of the service provider to issue traffic advisories to controlled aircraft about uncontrolled aircraft. Improved flight-following services for VFR traffic are also provided. VFR automatic position reports combined with flight data available via the SWIMS, reduces the workload associated with providing traffic advisories to uncontrolled aircraft. As in the departure and arrival phase, the service provider will have access to the SWIMS, which includes weather information, infrastructure status, and other conditions in the NAS.

Improved situation awareness in the cockpit, enabled by the CDTI display and improved navigation precision, allows some separation tasks to be performed by the flight crew. Situational awareness will be increased by monitoring all surrounding traffic with cockpit display of traffic information. Many of these aircraft will have a navigational capability coupled to an FMS. DoD aircraft equipped with a CDTI will have better situation awareness throughout the cruise phase of flight. Panel-mounted multi-function displays and data link capabilities will become commonplace in all but the low-end GA aircraft, where hand-held units remain the equipment of choice. In addition, satellite-based surveillance systems that enable robust multi-function capabilities will begin to appear in GA cockpits. Improved awareness of terrain separation and airspace orientation during the cruise portion of the flight will be enabled by the use of hand held or panel-mounted GPS units that include special use and ATC airspace boundaries supplemented by a terrain database. Multi-function displays will begin to appear in GA aircraft, providing weather and traffic information superimposed on a moving map.

In en route airspace, the use of moving maps for CFIT avoidance, CDTI, and weather depiction will be available. For properly equipped aircraft, updates to navigation terrain and obstacle databases will be provided via data link. Terrain databases will be supplemented with information on man-made obstacles. As GA users begin to equip with traffic displays, safety will be further enhanced as the potential for midair collisions is reduced. VFR flight-following services will also be enhanced. Basic flight information services are available via data link to properly equipped aircraft. Updated charts, current weather, SUA status, and other required data will be up-linked (or data-loaded) to the cockpit allowing for better strategic and tactical route and altitude planning.

Data link will also allow the aircraft crews and the service provider specialists to see the same weather and alerts. This information includes current and forecast weather, NOTAMs, and hazardous weather warnings. The pilot in en route airspace will have better downstream weather data information in digital form, both through automated means and through request/reply data link. A pilot will be able to obtain weather forecasts for not only the specific areas through which the aircraft will pass, but also the specific time at which the aircraft will pass through that area. More aircraft will provide real-time winds and temperatures aloft, resulting in better weather information for forecasting and traffic planning. Weather data will be distributed to decision support systems for processing and presentation to service providers, resulting in a more accurate and common awareness of meteorological conditions.

Oceanic Environment - The combination of satellite-based communications and electronic message routing enables the oceanic system to be more interactive and dynamic, supporting cooperative activities among flight crews, AOCs, and service providers. Service providers will use visual displays to monitor the traffic situation. Advanced oceanic weather detection capabilities and integration into automation systems will provide enhanced situational awareness. The AOC will provide additional user intent and aircraft performance data to decision support systems, thus improving the accuracy of ground-based trajectory predictions

Aircraft position updates are supplied by the aircraft's broadcast of satellite navigation-derived position data transmissions. To maximize flight efficiency, pilots may coordinate with service providers for clearance to conduct specified maneuvers while the pilot's view of nearby traffic supplements the service provider's big picture of longer-term traffic flow. Given the higher degree of responsibility in the cockpit, appropriate automation aids for monitoring the traffic situation will be provided to the pilot.

Full surveillance, better navigation tools, real-time communications and automated data exchange between the pilot and service provider via data link facilitate the transition away from tracks and toward trajectories in oceanic airspace. Satellite navigation systems and data link allows more accurate and frequent traffic position updates; data link and expanded radio coverage provide direct air-to-ground communications. Satellite-based communications are also the primary means for voice position reports. Pilots have situation awareness of nearby traffic through ADS-B/CDTI and use this information to enhance oceanic operations. This is also integrated with improved weather information. CDTI, used in conjunction with satellite-based navigation systems, allows more relaxed separation standards in oceanic airspace.

5.3.5 Navigation and Landing Enhancement Area

The transition to GPS for oceanic, en route, terminal, and non precision and precision approaches continues. GPS is used as the position reference in all applications of ADS-B. Suitable backups to GPS in the event of a failure are implemented, but as transition to GPS is completed, some ground-based aids to navigation are decommissioned.

Navigation and Landing Enhancement Operational Description

For future requirements to be satisfied, pilot and controller navigation and landing services must be enhanced. These services will be enhanced through the use of GPS, WAAS, and LAAS. The following paragraphs provide a description of the navigation and landing enhancement on the airport surface, in the terminal area, in en route airspace, and over the oceans.

Airport Surface - Satellite-based navigation services will be enhanced with the addition of LAAS that enable more accurate position information on all aircraft and vehicles operating on the airport surface. This will lead to improved situational awareness on the airport surface, and when combined with enhancements to separation assurance will result in an increase in safety particularly in low-visibility conditions. Service providers will display satellite-derived position data transmitted by selected flights upon request, while ground-based surveillance data will be shared with users as a safety enhancement for preventing incursions.

In the near future, GA users will have improved versions of the hand-held or panel-mounted GPS navigation equipment in use today. These devices have the potential for improving user situation awareness on ramps, taxiways, and runways through the use of moving map displays of the airport surface environment. ADS-B will allow for low-cost cockpit traffic displays, thus enhancing the pilot's perspective of surrounding surface traffic (aircraft and other vehicles in the airport movement area).

There will be limited navigation and terrain database services to update the databases used in the cockpit or hand-held avionics. Airport operations can continue in near zero visibility conditions at near normal visual rates based on the implementation of accurate position information (i.e., GPS/LAAS), a cockpit moving map overlaid with aircraft positions, and real-time data link information. Note that this concept must account for potential navigation system failure in order to maintain a robust operational system.

Terminal Area - In the future, a rapid proliferation of improved navigation capability will occur in aircraft of all user classifications. Improved navigation precision, coupled with changes in service provider separation procedures will allow an improved ability to accommodate user-preferred arrival/departure routes, climb/descent profiles, and runway assignment. Improved departure/arrival flows based on precision area navigation capabilities will be achieved through tools that provide more efficient airport surface operations, improved real time assessment of traffic activity in departure and en route airspace, and expanded usage of flexible routes based on Area Navigation (RNAV), satellite navigation, and FMS. The implementation of GPS/LAAS will facilitate the addition of precision approach capability to more airports, increasing all-weather access to an increasing number of airports. LAAS has the accuracy, availability, integrity, and continuity necessary for precision approaches. These approaches allow for optimum descent from cruise to the runway threshold. Widespread RNAV equipage and expanded surveillance coverage with new technology provide increased access to airports and airspace in poor weather conditions. Many more of the smaller GA airports will have some form of GPS based approach. The addition of enhanced collision avoidance logic based on satellite-based navigation and surveillance information will improve collision avoidance capabilities and will provide collision protection to the ground, including on closely spaced parallel approaches. Dependent and independent approaches/departures in IMC may be performed at many airports between properly equipped aircraft and by a properly trained flight crew. Published instrument approaches based on independent navigation systems, such as GPS/area navigation (RNAV)/inertial navigation system (INS)/FMS will be available and can be monitored on a moving map display. Next generation equipment and procedures (including Terminal Radar Procedures (TERPs)) to permit the design and implementation of LAAS precision approaches and precision departures/missed approaches to all runway ends will be developed to support Surface/Approach operations. Expanded departure and arrival route structures, within environmental constraints, to allow increased usage of RNAV, satellite navigation, and routes flown automatically by the onboard FMS.

The primary threat to GPS navigation is interference and intentional jamming. Interference will be most disruptive in the landing phase and any backup capability must at least support non precision approach capabilities. Thus, most major DoD aircraft will be equipped with multi-mode receivers capable of utilizing Instrument Landing System (ILS) and MLS as a backup to GPS (i.e., ILS/GPS, ILS/Microwave Landing System (MLS), and ILS/MLS/GPS) for precision approaches. Eventually it is expected that all DoD users will be equipped with augmented satellite-based navigation capabilities, data link, GPWS, cockpit display of traffic and weather information, and on-board collision avoidance.

En Route Airspace - An increasing number of aircraft will be equipped with satellite-based navigation, digital communications, and the capability to automatically transmit position data. The use of satellite-based navigation and surveillance data will not only increase on-board capabilities ranging from cockpit traffic and enhanced collision avoidance logic, but will also be used by ground-system automation for enhanced conflict probe and alerting. Many of these aircraft will also have these capabilities coupled to an FMS. FMS equipage, including coupled navigation capabilities, also allows for more efficient flight planning by the AOC. As a result of these developments, flights will be routinely operated on user-preferred en route trajectories, with fewer aircraft constrained to a fixed route structure. These trajectories will be accommodated earlier in the flight and continue closer to the destination than is currently allowed. As ground based navigation aids phase out with the continued transition to satellite navigation, the current route structure will be replaced with a global grid of named locations. These defined points will be used for coordination purposes, including transition points for flow initiatives, and as backup in the case of either airborne or ground based automation failures. Point-to-point navigation that allows the NAS airway structure to change as high altitude jet routes are phased out and as more flights at those altitudes are conducted with area navigation capabilities. Satellite-based navigation and augmentation systems will greatly expand IFR access to low altitude airspace, enhancing operations outside of radar coverage.

Aircraft equipped with satellite-based navigation will be afforded lower separation minima and procedural lateral offsets will allow passing maneuvers that require less airspace than needed today. In the future, more GA users will employ GPS as a primary means of navigation. Satellite-based surveillance systems that enable robust multi-function capabilities will begin to appear in GA cockpits. Panel-mounted multi-function displays and data link capabilities will become commonplace in all but the low-end GA aircraft, where hand-held units remain the equipment of choice. Improved awareness of terrain and airspace separation during the cruise portion of the flight will be enabled by the use of hand held or panel-mounted GPS units that include special use and ATC airspace boundaries supplemented by a terrain database. For properly equipped aircraft, updates to navigation terrain and obstacle databases will be provided over data link. For DoD users, the GPS will be increasingly used for en route and cruise navigation, supplemented by, but less reliant on ground-based NAVAIDs and inertial navigation systems.

FAA will reduce the number of ground-based navigation aids. Criteria for identifying the aids to be shut down will be published well ahead of time. NAS infrastructure services such as navigation and landing signals, and aeronautical information broadcasts will be provided directly to FAA customers.

ADS-B and radar data will be integrated or fused to improve surveillance coverage, accuracy, and update rate. These capabilities will better support automatic decision support tools and may lead to reduced separation standards. When ADS-B data and radar data exists on the same target, this information will be used to automatically calibrate the radar thus reducing radar bias errors and ADS-B/radar registration errors.

Oceanic Environment - The greatest percentage of increase in air traffic is projected to occur across the Atlantic and Pacific Oceans. To accommodate this growth, improvements in navigation, real-time communication and the use of full surveillance are paramount enablers of capacity enhancement in oceanic airspace. Oceanic separation minima will be significantly reduced, allowing a corresponding increase in traffic demand.

5.3.6 Traffic Management - Strategic Flow Enhancement Area

In the U.S., the air traffic management process is managed and operated by the FAA and is intended to ensure the safe and efficient movement of aircraft operating under IFR from takeoff to landing. Traffic flow management is responsible for ensuring that traffic flow into major terminal areas and other high density control areas is optimized, particularly at times when demand either exceeds or is anticipated to exceed the available capacity. As more and more UAVs and expendable and reusable space launch vehicles (ELVs, RLVs) come into use, strategic flow management will evolve to accommodate their unique requirements.

Traffic Management - Strategic Flow Enhancement Area Operational Environment

Traffic Management – Strategic Flow (TM-SF) affects all users similarly, although users with an AOC or AOC-like capability have an opportunity to collaborate more efficiently and effectively with TM-SF service providers to address specific flow restrictions. Therefore, unlike the preceding Enhancement Areas, the operational concepts for TM-SF are discussed at a high level for all users.

Improved Information - National and local TFM service providers will adapt to an environment of increased user flexibility, collaborative partnership, and information sharing among themselves and with the airspace users. Users and service providers alike will begin to experience the benefits of increased automated exchange of information between users and service providers. Timely and consistent information across the NAS will be made available for both user and service provider planning purposes. Improved information exchange among users and service providers will enable shared insight about weather, demand, and capacity conditions and allows for improved understanding of NAS status and TFM initiatives. Airspace users will increasingly use data link to exchange position, speed, altitude, intent, aircraft performance parameters, and weather information with the ATSP and AOCs. Infrastructure management will provide infrastructure information to users. Through collaborative decision making, future service providers will focus on providing the best, seamless service to all users. Users are key participants in the planning process of traffic flow initiatives. As users receive improved knowledge of the intent of traffic flow initiatives, they may arrange their own resources to help solve the flow problems.

Users will be better able to plan their flight operations in anticipation of NAS capacity and traffic conditions, and to minimize congestion or possible delays due to the comprehensive information made available by the SWIMS. Databases and decision support systems that use these databases will enable a shared view of traffic and weather among all parties so that proposed strategies can be evaluated. For example, in a severe weather situation, increased collaboration among users and service providers enables shared decisions on how to avoid the severe weather and deal with the resultant short-term capacity shortage.

TM-SF includes an executive flow unit dedicated to system-wide/international planning and coordination by the ATCSCC. The ATCSCC provides oversight to minimize system impact and equitably distribute the impact to the users. Service providers at the ATCSCC develop a NAS-wide understanding of conditions, capacity, and traffic flow to serve as a central point-of-contact for NAS users and local service providers. The demand-capacity balance of major traffic flows across the NAS is monitored by the ATCSCC with a broader strategic focus than local service providers. Particular attention is given to departure and arrival demand and runway configurations at major airports, SUA active status and schedules, special events, and en route traffic volume. This monitoring activity at the ATCSCC makes extensive use of predictive capabilities, enhanced by more comprehensive and current information from users and international service providers.

Site and national traffic managers' situation awareness and strategic planning will be based on a system-wide perspective that enhances the effectiveness of the overall NAS. Since conditions and events at one place in the NAS are generally predictive of events several hours in the future at other points in the NAS, the system can provide site and national traffic managers with extensive information on national environmental conditions, resource capacities, and traffic demand. This information will be presented in the form of 'national profiles' that describe national operational conditions, including the overall NAS environment, and national capacity and demand. This national operational environment information will provide all traffic managers with an overall view of conditions at cardinal points within the NAS that will affect operations from the current time through several hours into the future. National TFM service providers will continue to manage capacity control programs (CCPs) and flow initiatives to mitigate instances where demand exceeds capacity. However, more accurate data and user collaboration will reduce the frequency of such initiatives. Therefore, the programs will be primarily used in the case of infrastructure problems or when inclement weather prevails. Users assume the responsibility for adhering to allocated arrival times assigned by TFM. In some instances, international flights are included in these programs, providing for a more equitable distribution of impact and increasing the users' substitution options. Decision support systems will aid the national TFM service provider in monitoring user adherence to assigned arrival times. Air traffic service providers at the ATCSCC monitor traffic, weather and infrastructure across the NAS. They also manage and implement broad scope traffic restrictions, facilitate coordination among other domestic/international service providers, and interact with AOC facilities and other NAS user organizations. Continuous evaluation of traffic management initiatives, to determine their effectiveness and their impact on users, is the focus of these activities. The TFM infrastructure will be upgraded to an open client-server infrastructure in order to support planned enhancements

Improved Collaboration and Planning - Advance planning is performed to develop proposed responses to future events such as air shows, military exercises, commercial space launches, field assessments of prototype systems, space missions, etc. Revisions to schedules and routes are included in this set of information. For example, the ATCSCC receives flight cancellation information at the same time as an airport. They also receive information identifying how quickly the next aircraft would be available for take off (e.g., which aircraft have pushed back). It is the responsibility of service providers at local facilities to set such capacity measures as airport arrival acceptance rates. ATCSCC service providers also collaborate with domestic and international service providers, including other executive flow units, to provide for end-to-end flight planning predictability. The ATCSCC utilizes broader information on international traffic and aviation equipment in support of global traffic flow management. ATCSCC service providers play a lead role in improving overall NAS service by managing national programs that modify national procedures and techniques governing daily operations.

Traffic flow management is evolving to the philosophy of problem resolution at the lowest level possible. Local service providers will have access to the projected demand information for the day, as well as tools to strategically identify areas and times of higher density, TFM issues can be efficiently resolved at the local level. The ATCSCC stays informed about traffic flow restrictions initiated locally. Working with service providers at terminal and en route facilities, the ATCSCC also initiates and coordinates traffic flow restrictions of a broad scope, strategic/tactical nature when required. Service providers at the national TFM level monitor traffic, weather, and infrastructure across the NAS, manage and implement traffic restrictions of a broader scope, facilitate coordination among other domestic and international service providers, and interact with AOC facilities and other NAS users. Adjustments must be made to the airspace structure and/or trajectories when demand exceeds capacity. In oceanic airspace, these changes are coordinated with national and international traffic flow service providers. The NAS service provider has access to the projected demand information for the day and collaborates with international service providers to determine the daily airspace structure, identify and explore alternatives to potential capacity problems, and manage traffic over fixes including gateway entries. National TFM service providers also monitor NAS performance and adjust traffic management strategies as needed.

Increased automated information exchange among domestic/international service providers, and between service providers and users, supports seamless global air traffic management. Increased collaboration between service providers and users in problem resolution improves overall system effectiveness.

Airspace congestion management capabilities help the users manage their fleets in ways that are comparable to capabilities used to manage airport capacity imbalances. These capabilities include exchanging slots for the constrained area among company flights as well as improved collaborative rerouting around flow constrained areas down to the individual flight.

Improved Flow Management Planning - Upon completion of the National Airspace Review, tools and procedures will be in place for frequent evaluation (i.e., up to several times a day) of the airspace structure and anticipated traffic flows, with adjustments made accordingly. Due to this increased flexibility, the number and tasking of air traffic facilities may be modified to support dynamic traffic factors, rather than institutional requirements. Terminal-area route structures will be expanded, including those flown automatically by the onboard FMS. When the projected demand for airspace is at or near capacity and after collaboration between users and national TFM, a temporary route structure with transition points for moving to and from user trajectories will be identified. Airport and airspace congestion is managed by an allocation of the constrained resources to the users based on scheduled demand.

For ground delay programs, users are allocated capacity at the affected airport in the form of an arrival interval and the number of flights that may arrive in that interval. There are capabilities and strategies to manage airspace congestion that are comparable to those that are used to manage airport capacity imbalances. Strategic flow initiatives move from modifying demand within the constraints of the existing NAS resources into full realignment of NAS resources to best meet the traffic situation. Flow-constrained areas are managed by allocating access, collaborative rerouting, and realigning sectors and associated resources to provide maximum flow in the adjacent areas. User flight planning systems incorporate flow management constraints to use when planning. Contingency planning moves from maintaining some level of service in the face of serious infrastructure problems to maintaining the highest level of flow given the ability to dynamically reallocate assets. Additional improvements are expected to materialize through the Research and Development (R&D) process.

Improved Decision Support Tools - In the future, increased collaboration among local facilities, the ATCSCC and NAS users will be augmented by decision support systems that enable a shared view of traffic and weather with all parties. In addition, 'what-if' tools for both the service provider and the NAS user will improve flow strategy development, NAS performance monitoring and measurement, and will allow proposed strategies to be evaluated. Automation and decision support capabilities tailored for national TFM will furnish a global perspective and facilitate coordination among local and national traffic flow managers, thus improving the decision-making process. Because NAS users will have increased flexibility in planning routes and schedules, and because the NAS relies less on routine restrictions and fixed routes to structure traffic, managing NAS resources will become more dynamic and adaptive. Better decision support systems will help service providers visualize demand and manage the more complex traffic flows.

Decision support systems that evaluate NAS performance in real-time will enable the service provider to be more responsive and develop more effective traffic management strategies. This automation includes decision support systems for developing alternative airspace designs, simulating traffic through the NAS for each airspace structure proposal, and evaluating each proposal. Resolution of recurrent problems may include inter-facility coordination to analyze operational data, develop procedural changes, and negotiate with NAS users and local service providers. The analysis of NAS operations includes an assessment of the general effectiveness and fairness of flow constraints. Information from the analysis is entered into the SWIMS and helps identify compliance issues and incentives to improve collaborative flow planning. Information about arrival capacity allocations, reroute programs and other restrictions is automatically recorded, as is information from local facilities. The recorded information includes both predicted and actual conditions. During heavy traffic, a traffic management tool achieves the engineered airport acceptance rate while minimizing aircraft delays. The ability to plan for future flow constraints, instead of reacting to impose restrictions will support both ARTCCs and the TRACON in achieving these results. Routes are probed for flow constraints prior to filing, resulting in fewer reroutes. Under nominal, predictable conditions, the traffic management tool has the ability to predict when the volume of traffic will exceed the acceptable arrival rates well in advance of the traffic saturating the arrival controllers.

A key variation from current TM-SF operations is that the assignment of specific departure times during capacity constrained operations is replaced with the assignment of arrival "slots" to each user per period of time. This approach is commonly referred to as "control by time of arrival (CTA)." For example, under this approach, if an airport's capacity is reduced by 50%, each user is instructed to reduce their demand by 50%. In this CTA fashion, the role of compliance is shifted to the user so they may plan flights according to their unique operational requirements as well as business needs. The user then has the flexibility to manage the remaining slots however they deem efficient. Under this approach, both GA and DoD users would be able to make more effective use of NAS resources during reduced capacity conditions. Improved information about capacity constraints allows these users to adjust their operations accordingly, helping to resolve problems without TFM intervention. Another variation is the movement away from flight-specific strategic control to a more aggregate approach (e.g., flow "X" number of flights into an airport during a specified time period). Aggregate flow directives are used based on an assessment of whether or not other TFM initiatives can be applied in an aggregate manner. To anticipate where and when demand might exceed capacity, both local and national traffic flow managers rely on decision support systems. For example, areas and times of high demand across the NAS are predicted by identifying optimal wind routes, determined through analysis of upper air winds information. A decision support system helps the service provider evaluate the impact of proposed strategies on the NAS by identifying options for avoiding problematic traffic situations. Ground delay programs, or capacity management programs, are exercised using an approach called rationing by schedule. For scheduled air carriers, this approach preserves the desired arrival order and reduces bank disruptions at hub airports. When a demand/capacity imbalance exists, the system develops Demand Modulation Schedules (DMS) for arrival, departure, and en route traffic. Each DMS assesses the times at which flights must depart or reach specified resources. To modulate demand to meet the capacity of each relevant resource, the DMS for that resource provides a Demand Modulation Time (DMT) and a Free Flow Time (FFT) for each relevant aircraft. DMTs are assigned to fit demand to capacity. DMTs are assigned to fit demand to capacity at affected resources by specifying the times at which flights must enter a sector. FFTs indicate the time the flight would arrive at the resource under unrestricted operations. The service providers use the initial surface movement DMTs/FFT as a guideline for developing the most efficient queue for each runway. The system automatically determines when actual Initial Surface Movement (ISM) times diverge from the plan, and recalculates the ISM DMTs and departure plans of subsequent flights. To assist the airlines further, an expansion of the air route networks and increased traffic flows particularly between regional and major hub airports will allow airlines to respond to competition from other modes of transportation.

Enhanced decision support systems improve NAS monitoring, performance measurement, and strategy development. Automation and decision support capabilities tailored for the ATCSCC provide a global perspective and facilitate coordination among local and national traffic flow managers to improve decision making.

A specific AATT tool that addresses the capabilities identified in this enhancement area is SWEPT. SWEPT represents the next generation of TFM decision support tools (DSTs) that will improve the capabilities of the ATCSCC and TMUs to evaluate traffic flow management problems and initiatives that could be implemented to ameliorate such problems. The exact objectives and scope of SWEPT are not yet established however the following three modes of operation are being considered.

SWEPT Real-Time Mode: In real-time mode, the objective is to support ATCSCC and local TFM specialists in the development and monitoring of TFM initiatives. Some capabilities include:

- Connectivity to ETMS for static (boundaries, waypoints, etc.), dynamic (tracks, flight plans, etc.), weather (CCFP, etc.), and TFM advisory information.
- Monitoring of aircraft conformance with active advisories to identify impediments to initiative effectiveness. This capability will permit the ATCSCC to monitor the conformance of traffic flows to plays that have been initiated from the National Severe Weather Playbook and evaluate the effectiveness of such plays in alleviating traffic flow constraints. The ATCSCC will be able to determine which airline/aircraft are impacted by a play (or multiple initiatives) and how such airlines/aircraft are conforming to the desired actions.
- Planning capabilities (including simulation) to determine effective initiative modifications to alleviate impediments.

SWEPT will have alternative ways of representing congestion data taking into account relevant metrics and measures. It may integrate other TFM tools (e.g., FSM, POET, and DSP).

This mode will also serve as a hardware/software platform for developing additional real-time analysis and monitoring capabilities for the ATCSCC and TMUs.

SWEPT Off-Line Mode: In off-line mode, the objective is to analyze previous day initiatives for quality assurance. Some capabilities include:

- Performing fast-time playback of previous day situations with analysis capabilities to determine causes of initiative ineffectiveness.
- Simulation capability to try determine the effectiveness of alternate initiatives during these situations.
- Statistics generation to support reporting requirements.

SWEPT may have a capability to develop and evaluate new flow management procedures and methods using a flexible simulation environment build upon the FACET capabilities. It will have a number of submodes of operation that are yet to be determined. They may include:

- A training capability
- A real-time database of predicted trajectories to complement ETMS historical databases.

SWEPT Research Mode: It is desirable that researchers at NASA and the FAA have a SWEPT-like capability in order to support research into improve TFM tools. A Research Mode for SWEPT will represent that capability. It will support rapid prototyping and integration of any new tools into the operational SWEPT.

Accommodation of UAVs, ELVs, and RLVs - There are space launch/reentry sites at coastal, inland, and sea-based locations. As a result, a variety of space vehicles operate in the NAS. These vehicles include traditional ELVs that operate predominantly from U.S. federal launch ranges, and RLVs that operate from a variety of launch/reentry sites around the country. ELV and RLV operations utilize various types of ATC clearances, as determined by vehicle characteristics such as mode of launch and reentry, pilot technique, avionics equipage, trajectory predictability, etc. Vehicles that perform comparably to conventional aircraft may be handled in manner similar to those aircraft. Traditional ELVs require dynamically reserved airspace to provide separation assurance. SUA reservations are based on the characteristics of the vehicles and the priority of the use.

Space transportation users request Altitude Reservations (ALTRVs), or temporary, geographical, special use airspace from surface to unlimited. ALTRVs are filed through the Central Altitude Reservation Facility (CARF) which is part of the FAA ATCSCC. Control of scheduling and flight planning rests with the DoD for operations from federal launch ranges. Commercial users exercise control of scheduling and flight planning from non-federal launch sites.

Space vehicle flight profiles describe user needs and take into account flow conditions and constraints. The SWIMS enables domestic and international users and service providers to access flight profiles and associated SUA data. Launch and recovery operations are more predictable, allowing service providers to exercise tighter coordination of user requests for system resources. Four-dimensional flight profiles replace surface to unlimited ALTRVs and commercial use of previous DoD planning resources.

The majority of launches occur from U.S. launch bases and ranges. The FAA provides traffic management and separation assurance to vehicles as they transition through the NAS to and from space. ELVs and RLVs utilize airspace volumes that are dynamically reserved and released to allow the vehicles to transition through the NAS from sites other than the federal launch bases and ranges. The reserved airspace volumes are selected based on performance characteristics of the vehicle and overall safety considerations. The airspace volumes are tailored as mission needs or NAS needs dictate, in order to provide more flexibility than today's SUA.

5.3.7 Traffic Management - Synchronization Enhancement Area

Enhanced traffic management-synchronization is an essential element of the Free Flight concept embodied in the FAA and RTCA operational concepts. The future traffic management-synchronization services will be based upon the enhancement of the near-term system capabilities resulting from the “real time” sharing of information regarding the NAS, traffic, weather, and system demand.

An increased usage of decision support systems that provide information to support the providers in their tasks. These tools reduce the burden of routine tasks while increasing the provider’s ability to evaluate traffic situations and plan the appropriate response. This increases productivity and provides greater flexibility to user operations, which is especially important given the potential for reduced vertical separation minima and increased traffic density.

The specific AATT decision support tools for which OCDs have been developed and that apply to this enhancement area are:

- Direct-To (D2)
- Expedite Departure Path (EDP)
- Multi-Center Traffic Management Advisor (TMA-MC)
- Surface Management System (SMS)
- Regional Metering (RM)
- DAG CE-5 En Route Free Maneuvering
- DAG CE-6 En Route Trajectory Negotiation
- DAG CE-11 Terminal Arrival: Self Spacing for Merging and In-Trail Separation

As a result of the new systems in place, traffic demand increases significantly without a corresponding increase in the controller workforce. Furthermore, controller workload under peak traffic remains equivalent to the workload controllers absorbed in the 1990s under lighter traffic demand. This increased ATC efficiency has been achieved through the implementation of DSTs for traffic management and control, dynamic alteration of airspace boundaries, reduced vertical separation minima, improved air-to-ground communications and coordination, and enhanced ground-to-ground coordination aids.

Traffic Management - Synchronization Enhancement Operational Description

For future requirements to be satisfied, pilot and controller traffic management-synchronization services must be enhanced. These services will be enhanced through improved surveillance and communication capabilities and the implementation of decision support tools both on-board the aircraft and in the ATC automation system. The following paragraphs provide a description of the traffic management-synchronization enhancement on the airport surface, in the terminal area, in en route airspace, and over the oceans.

Airport Surface - Surface movement is both the first and last step in the progress of a flight through the NAS. With no expected increase in the number of available runways or taxiways, the goal of the service provider is to remove system constraints on flights moving from pushback to the runway, and from the runway to the gate. Elimination of these constraints minimizes the overall ground delay of arrivals and departures.

Cohesive taxi plans are developed to facilitate aircraft parking and the flow of vehicular traffic. Automation aids for dynamic planning of surface movements provide methods and incentives for collaborative problem solving by users and service providers. The management of excess demand is improved through balanced taxiway usage and improved sequencing of aircraft to the departure threshold.

Integration of surface automation with departure and arrival automation facilitates the coordination of all surface activities. Runway and taxiway assignments are based on projected arrival/departure runway loading and surface congestion, user runway preference and gate assignment, and environmental considerations such as noise abatement and gaseous emissions. This latter environmental impact will also be taken into account when defining operational ATM improvements. Arrival runway and taxiway assignments are planned early in the arrival phase of flight. Departure assignments are made when the flight profile is filed, and updated accordingly until the time of pushback. Improved planning that allows flights to depart immediately after de-icing improves both efficiency and safety. Automation to monitor and predict the movement of ground vehicles provides further safety enhancements through improved conflict advisories.

Surface movement operations involve numerous activities to maneuver traffic between runways and gates. In performing those activities today, communication and coordination consume most of the service provider's time. Surface movement decision support systems are planned as an integral part of the total NAS automation system. This ensures that surface initiatives and user preferences are not at cross-purposes with information being generated by airspace automation systems. Thus, runway assignments, in departure and arrival automation, are based not only on the location of the assigned gate but also on the surface automation's prediction of congestion and related taxi plans. Current flight information integrated with service provider surface, departure and arrival automation, results in a realistic set of schedules for departures, arrivals, and surface traffic. Traffic flow service providers oversee surface movement operations by analyzing the operational situation and establishing initial parameters for surface movement planning. In the process, these service providers will establish initial taxi-times based on weather and airport configurations, and establish aircraft movement times required to accomplish deicing with minimal delay from station to departure. The service provider will evaluate results and adjust parameters as needed. Both the initial values and subsequent adjustments will be incorporated into the surface management information system to ensure consistency and an integrated approach across systems. At busy airports, there will be a traffic flow service provider in the tower.

Airport surface operations include coordination with ATC regarding pushback and departure times. Departure clearances will be issued via data link at more airports and to more users than is feasible today. In addition, automation functions will utilize these departure clearances, along with aircraft location and aircraft type, to generate taxi schedules. Thus departures will be spaced more efficiently than they are today, resulting in reduced taxi times. Pushback clearances include specific aircraft location and type as well as sequencing number for more efficient taxi planning, thus reducing taxi times and departure delays. In today's environment, the pilot is responsible for pushing back from the gate to meet departure-time constraints, for maneuvering the aircraft to the appropriate taxiway, and for maintaining separation while in transit to the airport movement area. Ramp service providers (either FAA or airline personnel) manage the movement of aircraft across ramp areas to the gates. However, in the near future, ramp service providers, where used, will sequence and meter aircraft movement at gates and on ramps, using situation displays that interface with decision support systems and personnel in the control tower. Safety will be enhanced by these situation displays which include airborne and surface traffic as well as information from the surface management information system.

This information aids in sequencing gate arrivals and departures in concert with the taxi planning system. DoD NAS users will continue to receive surface movement instructions by personnel and equipment in the ATC tower.

The future NAS will become more integrated, as surface-movement decision support systems provide real time data to the SWIMS. After proper coordination with the AOC and the air traffic ground controller, the flight crew can push back and begin taxi to the appropriate runway. Upon pushback, the flight's time-based trajectory will be updated in the SWIMS, based on the average taxi time at the airport under prevailing traffic conditions. Taxi Planning will be significantly improved through timely availability of traffic activity information. In today's environment, the lack of accurate departure information results in taxi and departure delays. These delays are compounded in many cases by multiple flights scheduled for departure at the same time, since taxiway queues are essentially based on first-come, first-served. In the future, as the aircraft prepares to taxi, service providers will use decision support systems to determine taxi sequencing (based largely on user preference), and to perform conformance monitoring and conflict checking. Since this automated planning process will share information with the surface situation monitoring systems, the resulting taxi plan will balance the efficiency of the movement with the probability it can be executed without change. For departures, taxi time updates and the associated estimates included in the taxi plan will be coordinated automatically with airspace automation to efficiently sequence ground traffic to match projected traffic flows aloft. The decision support system will incorporate departure times, aircraft type, wake turbulence criteria, and departure routes to safely and efficiently sequence aircraft to the departure threshold. For arrivals, the decision support system will consider the assigned gate to minimize taxi time after landing. Additionally, improved knowledge of aircraft intent will allow automatic monitoring of taxi plan execution and provides alerts to the potential for runway incursion.

At some airports today, tower automation performs surface conflict detection; in the future, enhancements will be made to this automation that take advantage of the improved accuracy of satellite-based navigation and surveillance. Tower and ground service providers at some major airports will use tower decision support systems that facilitates airport operations. It will contain information about the airport environmental and operating conditions and will enable exchange of information and requests between the tower, airport operations, and ground service providers. The use of decision support systems to coordinate local operations with other airport operations will improve the efficiency of airport surface movements. Tower automation will also provide schedules for arrivals, departures and surface traffic using flight schedule information.

A specific AATT tool that addresses the future surface capabilities identified in this enhancement area is SMS. NASA Ames Research Center, in cooperation with the FAA, is developing the SMS, a decision support tool that helps controllers and air carriers collaboratively manage the movements of aircraft on the surface of busy airports, thereby improving capacity, efficiency, and flexibility.

Detailed information about the future departure demand on airport resources is not currently available in real-time to operational specialists at air traffic control (ATC) facilities and air carriers. SMS provides controllers, traffic managers, and air carrier decision-makers with accurate predictions of the future departure situation (e.g., queuing and delays for individual aircraft, and aggregate demand for each runway or other constrained resources), as well as advisories to help manage surface movements and departure operations.

SMS will predict departure demand over a time horizon similar to that over which the Center-TRACON Automation System (CTAS) Traffic Management Advisor (TMA) supports arrival management using surface surveillance, surface trajectory synthesis algorithms that are functionally equivalent to the CTAS airborne trajectory modeling algorithms, and air carrier predictions of when each flight will want to push back. SMS will provide near-term predictions of departure sequences, times, queues, and delays for runways or other resources to support tactical control of surface operations, and longer time-horizon forecasts of aggregate departure demand (i.e., total demand per intervals of time) to support strategic surface planning. Initially, SMS will display this information in the ATC tower (ATCT) and air carrier ramp towers. In the future, SMS may also display information in the TRACON Traffic Management Unit (TMU), Center TMU, and Airline Operations Centers (AOCs). Displays similar to TMA timelines and load graphs may be used, depending on the recommendations from human factors studies.

SMS will also use its ability to predict the future state of the airport surface to support departure management decisions. For example, SMS will aid the ATCT in constructing departure sequences that efficiently satisfy various departure restrictions (e.g., Miles-in-Trail (MIT) and Expected Departure Clearance Times (EDCTs)). Subsequent development efforts will extend SMS to interoperate with arrival and departure traffic management decision support tools (e.g., the CTAS Final Approach Spacing Tool (FAST), TMA, and Expedite Departure Path (EDP) tool) to provide additional benefits (e.g., coordination of arrival/departure interactions).

Terminal Area - Departure and arrival planning involves the sequencing and spacing of arrivals, and the integration of departures into the airborne traffic environment. In the future, decision support systems will help the service provider to assign runways and merge/sequence traffic, based on accurate traffic projections and user preferences. Improved departure flows will be achieved through tools that provide more efficient airport surface operations, improve real time assessment of traffic activity in departure and en route airspace, and expand usage of flexible routes based on RNAV, satellite navigation, and FMS. Arrival operations will also benefit from these tools. Runway assignment will be made early in the arrival phase of flight. The user's runway assignment preference will be available through the flight object within the NAS information system, and is used in conjunction with departure and arrival decision support systems, such as TMA and Final Approach Spacing Tool (FAST), and the integrated surface management tool to coordinate an optimal assignment. Real-time trajectory updates reflect more realistic departure times, resulting in more accurate traffic load predictions, and increased flexibility due to the imposition of fewer restrictions.

In the final portion of the arrival phase, decision support systems will facilitate the use of time-based metering to maximize airspace and airport capacity. Procedures may be implemented that take advantage of additional runway and airport capacity increases at various locations. Other tools will generate advisories to the service provider that aid in maneuvering flights onto the final approach in accordance with the planned traffic sequence. Improved service provider automation and displays and the use of cockpit situation displays will enhance traffic situational awareness and allow for enhanced approaches and departures. On final approach, the service provider may give the pilot responsibility for station keeping to maintain the required sequence and spacing to the runway. Dependent and independent approaches/departures in IMC may be performed at many airports between properly equipped aircraft and by a properly trained flight crew. As a result, increased capacity and greatly reduced delays during IMC are realized at airports with closely spaced parallel runways. Display enhancements will also provide benefits for planning and monitoring arrivals and departures to and from converging runways and approach or departure waypoints. Enhanced weather data and weather alerts will also be output on service provider displays, and simultaneously uplinked for display on the flight deck. These displays will improve the service provider's ability to coordinate with the flight deck and with other service providers to ensure the avoidance of hazardous weather.

When traffic management initiatives are required, service providers will collaborate with users to resolve congestion problems through adjustment of user schedules and incorporation of user preferences such as desired arrival or departure sequences. If these adjustments do not adequately resolve the problem, the service providers will work with the national traffic management function to solicit user input concerning flow constraints, and these constraints will be entered into the SWIMS as planned or current operational requirements. Systems for obtaining and distributing user input will be made available to both service providers and NAS users. Airspace users will increasingly use data link to exchange position, speed, altitude, intent, aircraft performance parameters, and weather information with the ATSP and AOCs. User-ATSP exchange of state and intent data will improve the accuracy of, and consistency between, FMS and ground-based trajectory predictions. Before changing a flight's trajectory, the controller must ensure not only that the revised trajectory is free of conflicts, but that the transition to that trajectory is also conflict free. The system therefore provides a 'trial plan' conflict probe for testing alternative trajectories. This will facilitates more effective collaborative decision making, with the AOCs collaborating with ATM in deciding TFM initiatives, which will then be data linked to the pilots.

To enhance operations during peak capacity periods, arrival operations will be enhanced by taking advantage of aircraft FMS to enable the Required Time of Arrival (RTA) at designated approach points. Procedures are being developed for reduced visual approach and departure minima. Approach types include FMS offset approaches/departures combined with vertical as well as horizontal separation between aircraft. Speed control in relation to traffic of interest will be required, but may be obtained procedurally (e.g., assigned speeds) or with reference to the CDTI (e.g., station keeping.). Once proven in visual conditions, these approach/departure procedures may be further developed for use in instrument meteorological conditions. A future goal is to allow turbojet and turboprop aircraft to plan and execute an optimal descent profile to land in a sequence that maximizes airport capacity. This will reduce exposure between high and low performance aircraft and releases lower altitude airspace for use by lower performance aircraft. It will also permit more efficient operation of high performance aircraft. For sudden or unexpected reductions in airport arrival rates, traditional airborne holdings will continue to be used. However, its use will be significantly reduced by enhanced arrival procedures and advanced aircraft avionics.

Three specific AATT tools that address the future terminal capabilities identified in this enhancement area are EDP, DAG CE-11, and TMA-MC.

The primary purpose of EDP is to increase the efficiency of departure operations while maintaining or increasing current levels of safety. EDP is also expected to provide a multitude of environmental compatibility enhancements to current departure traffic management practices: reduced fuel burn, reduced noise impact, and reduced terminal area emissions. Lastly, EDP will provide accurate pre-departure time-to-fly estimates to ground-based departure planning tools, significantly enhancing their ability to match airspace throughput to capacity (and reduce taxi delays).

EDP is a decision support tool aimed at providing TRACON TMCs with pertinent departure traffic loading and scheduling information, and radar controllers with advisories for tactical control of TRACON departure traffic. EDP employs the CTAS trajectory synthesis routine to provide conflict-free altitude, speed and heading advisories. These advisories will assist the TRACON departure controller in efficiently sequencing, spacing and merging departure aircraft into the en route traffic flow. The anticipated benefits of EDP include a reduction in airborne delay for departure aircraft, reduced fuel burn and reduced noise impact due to expedited climb trajectories. EDP will eventually share information with both surface and arrival decision support tools to form an integrated decision support system capable of planning, coordinating and executing highly efficient terminal airspace operations

EDP is intended to provide optimized schedules and advisories to departure controllers, while meeting constraints from flow control and ensuring the efficient and safe flow of outbound traffic from airports into en route control sectors. EDP is designed to provide climb profiles as well as lateral path guidance that should allow efficient, uninterrupted climb-out, and safe merge of the flight into en route traffic.

DAG CE 11 will bring greater runway throughput and flight efficiency at busy terminal areas and runways by providing the capability for the flight crew to adhere to strategic clearances such as maintaining precise time spacing with other aircraft.

The general idea behind the concept is that implementing a distributed control system, possibly involving integrating the FMS and CDTI avionics with the ATM system, would enable the FC to provide tighter control of the merging and spacing processes. The excess spacing buffers that exist between consecutive aircraft during approach could be reduced. This spacing buffer reduction could increase runway throughput. In addition, voice communications between the FC and the controller should be reduced which may permit additional throughput at busy airports.

This concept is based on the general hypothesis that enabling distributed approach control conducted by the individual participating FCs would provide greater flight efficiency and other benefits and would be more cost effective than providing the air traffic service provider (ATSP) with more automation tools to pursue the same benefits. Future research experiments are to be conducted to prove or disprove this hypothesis.

A basic premise of CE 11 is that a designated “string leader” aircraft follows a desired speed profile from TRACON entry to the Final Approach Fix (FAF) or threshold. The next arriving aircraft is cleared by ATM to merge behind the immediate Lead and then to self-space according to some accepted spacing criterion. This second aircraft then becomes the Lead aircraft for the next (third) arrival aircraft in the string, etc. Various specified spacing gaps are used to account for different wake vortex spacing constraints based upon aircraft type, and allowances for departing aircraft on the runway. Also, natural spacing gaps will occur because of the distribution of arrival aircraft over time. Thus, there will be need to re-start the strings from time to time.

TMA-MC is the extension of TMA-SC to regions where multi-center coordination is required. Ideally, TMA-MC and TMA-SC would be identical, except for the need to coordinate TMA-generated planning information between the facilities. Therefore, TMA-MC will operate in the same way as TMA-SC with minimal restrictions added for acceptable joint facility operation.

One of the ARTCCs involved in the flow management process is assigned the responsibility of entering scheduling parameters into the TMA-MC system. It is expected that the ARTCC TMU whose host computer is associated with the TRACON approach control will make these entries. In general, every TRACON has one and only one controlling ARTCC from a TMA-MC perspective. Any ARTCCs that are computing ETAs for aircraft bound to a TRACON that the ARTCC does not control would send the ETA information to the TMA-MC system in the controlling ARTCC. The planning function in the controlling ARTCC TMA-MC would create the integrated schedule for all flights arriving at the primary airport and send the STAs back to the contributing CTAS systems.

The parameters entered by the controlling ARTCC TMC appear on all TMA displays, including those at the supporting ARTCCs, the TRACON and the ATCSCC. The availability of a TMA display at the ATCSCC would enhance the collaborative planning between ATC facilities. In addition to the scheduling parameters, all TMA displays show the schedule that has been developed by the controlling ARTCC. This schedule assigns airport and arrival fix crossing times to flights to make efficient use of airport arrival capacity and to equitably distribute delay among flights.

After the schedule has been modified by the controlling ARTCC TMC to manage flow and workload, the scheduled arrival fix crossing times are broadcast from the controlling ARTCC TMA to the sector controller displays. The implementation of TBM by the controller in the TMA-MC case follows the same procedures as the TMA-SC case. Controllers give speed and descent clearances and use vectors to control flights to cross the arrival fix at the assigned time. If necessary, controllers can swap the assigned slots for flights that have the same approach speed profiles. The complexity and congestion of the TMA-MC airspace may cause unavoidable delay. This may, in turn, cause some flights to miss their assigned arrival fix crossing time. The frequency of occurrence of this phenomenon and the severity of impact on the overall arrival situation will be the subject of further analysis. As the TBM plan is being implemented, TMCs at the TRACON monitor performance and evaluate the need for re-planning of the arrival schedule.

En Route Environment - The goal for future en route operations is to allow turbojet and turboprop aircraft to fly at a user selected altitude that optimizes the cost function most important to the specific flight, and to remain at that altitude until the point is reached from which an optimum descent profile should commence. New displays will be operational in all en route facilities and the service provider will have access to more accurate forecasts of potential conflicts. Decision support systems such as the conflict probe will assist the provider in developing safe and effective traffic solutions and will allow for greater user flexibility in requesting and being cleared for user-preferred routings.. They will also help service providers to collaborate with users when SUA restrictions are later removed or changed. Additional intent and aircraft performance data will be provided to decision support systems, thus improving the accuracy of trajectory predictions. As in the departure and arrival phase, the service provider will have access to the SWIMS, which includes weather information, infrastructure status, and other conditions in the NAS. The status of active and proposed flights and NAS infrastructure will be available to NAS users and service providers. This will facilitate more effective collaborative decision making, allowing users to collaborate with ATM in deciding TFM initiatives. The ATSP will also have access to a predicted demand profile for the entire day. The profile will be produced through improved information sharing, collaborative decision making, and the projection of flows based on weather and wind patterns. This information will be used, in coordination with the national flow management and other en route traffic flow facilities, to determine the daily airspace structure. Any capacity problems due to SUA schedules, staffing, or weather are identified.

As in previous portions of flight, complementary digital communication systems will enable datalinking of routine communications such as frequency changes or certain clearances. This automated coordination will reduce the amount of time pilots and service providers spend on routine tasks, allowing more time to address other issues such as user requests. The pilot in en route airspace will have better downstream weather data information in digital form, both through automated means and through request/reply data link. A pilot will be able to obtain weather forecasts for not only the specific areas through which the aircraft will pass, but also the specific time at which the aircraft will pass through that area. More aircraft will provide real-time winds and temperatures aloft, resulting in better weather information for forecasting and traffic planning. Weather data will be distributed to decision support systems for processing and presentation to service providers, resulting in a more accurate and common awareness of meteorological conditions. While separation assurance will remain the responsibility of the controller, improved situation awareness in the cockpit, enabled by the CDTI display and improved navigation precision, will allow some separation tasks to be performed by the flight crew. These metering and merging separation procedures could provide the crew the flexibility to more efficiently manage their flight with respect to aircraft performance, crew preferences, and ATC considerations by allowing the aircraft to stay on the cleared route in cases where ATC would otherwise have to vector the aircraft to achieve the desired spacing. The option to stay on route improves fuel and time efficiency.

In the future, en route airspace structures and boundary restrictions will be unconstrained by communications and computer systems, and aircraft will no longer be required to fly directly between NAVAIDs along routes defined by the FAA.

En route service providers currently use a variety of specific flow constraints to manage traffic departing from or landing at underlying airports, and transiting their portion of en route airspace. In the near future, increased information exchange between the en route, arrival, departure and surface decision support tools will enable better coordination of cross-facility traffic flows with fewer constraints. These improved capabilities will also allow for greater accommodation of user requests, including carrier preferences on the sequencing of their arrival aircraft. The traffic flow service provider will have the same automation tools as those providing separation assurance. By resetting control parameters (such as conflict detection look-ahead time) the probe becomes a density tool which the service provider uses to identify areas and times of higher density. By working strategically with upstream separation assurance providers and the users, some density problems will be mitigated with minimal impact on the users and without the need to move to more formal traffic flow initiatives. The service provider will also be involved in the coordination of modified flight trajectories for active flights. The use of the SWIMS and the flight object means that any changes in the NAS airspace structure, including activation of SUA or the need to create temporary route structures, will ripple back through the information system and identify all flights whose trajectories penetrate the changed airspace. This will allow earlier and immediate coordination with either the pilot or the airline operations center to provide adjustments with minimal intervention and movement. Traffic flow service providers will work with the service provider in active communication with the pilot to re-plan the flight trajectory. Modified trajectories will also be developed collaboratively with the airline operations center and distributed to the flight deck via data link, and to downstream facilities via the SWIMS.

Four specific AATT tools that address the future en route capabilities identified in this enhancement area are D2, RM, DAG CE-5, and DAG CE-6.

D2 is an R-side controller decision support tool that helps controllers work more efficiently and facilitates flying time savings for airspace users. D2 provides advisories for traffic conflicts and time saving direct routing opportunities and includes a rapid feedback trial-planning function that allows the controller to quickly visualize, analyze, and input route and altitude changes. The D2 user interface will be fully integrated with the R-side Traffic Situation Display (TSD). D2 is based on CTAS trajectory analysis methodology and software. All CTAS tools use common software for input data processing and 4D trajectory synthesis. D2 functionality is available by connecting one additional software module to an existing CTAS TMA system.

D2 route advisories and conflict information are displayed in the flight data block and in optional lists on the controller's traffic display. A mouse (or track-ball) click on a conflict advisory, either in the flight data block or the Conflict List, toggles a graphic display of conflict information. A mouse click on the data block activates the trial planning function which shows a graphic display of the trial route, and analyzes the route for traffic conflicts, preferential routing restrictions, and flying time. The trial planner allows the controller to quickly select a different fix and/or add an auxiliary waypoint, by a point and click action. A final mouse click sends the flight plan amendment to the Host computer.

RM is a novel approach to solving TFM congestion problems at a local and regional level safely, effectively, efficiently, and in collaboration with airspace users. RM fills an operational gap between national (strategic) TFM actions on a 3-6 hour time horizon, and local arrival metering (a la CTAS TMA) on a 20-40 minute time horizon. This gap includes the regional (inter-Center) metering of arrivals upstream of TMA-served airports, local metering of arrivals to airports not supported by TMA/McTMA, and RM of airspace congestion (independent of destination. It further improves CDM and ensures more equitable distribution of delays.

RM operationally replaces the inefficient practice of MIT spacing with a more general, flexible, adaptable, and efficient technique of time based metering. The approach emphasizes control at the local level to enable air traffic service providers with adequate flow controls while maximizing discretion at the local level as to how flow restrictions are conformed to. By orienting TFM restrictions to a time basis, RM enables TMCs to better orchestrate flows from multiple directions and more equitably distribute delays. The time basis also facilitates the CDM concept of Delay Banking. By leveraging CTAS technology to form the building blocks of RM, this capability can be integrated with the other CTAS tools to form a cohesive set of decision support capabilities for en route airspace.

The purpose of DAG-TM CE 5 is to eliminate excessive and non-preferred trajectory deviations resulting from separation assurance and/or local TFM conformance constraints. Another major purpose is to distribute the separation assurance and tactical traffic management functions to the flight deck, greatly adding to the “scalability” of the system. Finally, CE 5 will allow greater user flexibility and autonomy that is consistent with the goals of the industry efforts towards Free Flight.

Appropriately equipped aircraft accept the responsibility to maintain separation from other aircraft, while exercising the authority to freely maneuver in en route airspace in order to establish a new user-preferred trajectory that conforms to any active local TFM constraints.

The purpose of DAG-TM CE 6 is to integrate flight deck (FD) and air traffic service provider (ATSP) automation to reduce controller workload, reduce flight path deviations, and to enable user preferred trajectories (UPT).

CE 6 will accomplish this purpose through:

- Basic data exchange between ATC and an aircraft/user to support the calibration of air and ground decision support capabilities;
- User and ATSP negotiation for user-preferred trajectory changes:
    - The user formulates UPT (based on constraints) and transmits to the ATSP
    - The ATSP evaluates UPT for approval and amends constraints as needed
- CTAS-FMS integration to facilitate:
    - Reduced datalink/CTAS input workload
    - Trajectory-based clearances and improved flight conformance

DAG-TM CE 6 provides an ATSP focus for implementing en route trajectory negotiation within the framework of distributed decision-making between users and the ATSP. The ATSP retains full responsibility for separation assurance, but users are integrated into the solution processes. Users are able to exercise initiatives and participate in the en route decision-making processes pertaining to the resolution of traffic problems (conflicts and conformance with TFM constraints). CE 6 provides the mechanisms for dynamically incorporating user-determined trajectory data and preferences into the assessment and the resolution or avoidance of potential violations.

These mechanisms include processes for exchanging information, identifying and evaluating complex traffic situations, and determining and implementing solutions.

Oceanic Environment - In the future, reduced separation minima and dynamic management of route structures will help the user formulate and request a preferred flight profile. Most aircraft will navigate using a global satellite navigation system whose improved accuracy will generate the required safety for reduced separation standards. Aircraft position updates will supplied by the aircraft's broadcast of satellite navigation-derived position data transmissions. The combination of satellite-based communications and electronic message routing will enable the oceanic system to be more interactive and dynamic, supporting cooperative activities among flight crews, AOCs, and service providers. Service providers will use visual displays to monitor the traffic situation. Advanced oceanic weather detection capabilities and integration into automation systems will provide better situational awareness. To maximize flight efficiency, pilots may coordinate with service providers for clearance to conduct specified maneuvers while the pilot's view of nearby traffic supplements the service provider's big picture of longer-term traffic flow. When operationally advantageous, pilots may obtain clearance to conduct specified cockpit self-separation operations and for special maneuvers such as station keeping with reduced spacing. The pilot's ability to support climbs, descents, crossing and merging routes will be supplemented by the service provider's conflict probe decision support system. In these carefully defined situations, the pilot's view of nearby traffic will supplement the service provider's big picture of longer-term traffic flow ATC oversight is still required for sequencing and separation assurance, but collaborative decision making will be greatly increased among the service provider, AOC, and the aircraft. Cockpit self-separation will provide immediate situation assessment, communications (i.e., air to air), and decision-making. This tighter cockpit self-separation decision/control loop may lead to greatly reduced separation standards. Given the higher degree of responsibility in the cockpit, appropriate automation aids for monitoring the traffic situation are provided to the pilot. These capabilities will allow for enhanced fuel efficiency and greater flexibility for pilots and controllers to avoid adverse turbulence and weather as well as to reduce the possibility of costly diversions. New advancements in Air Traffic Control decision support tools, data link communications, surveillance, and navigation will facilitate merging domestic en route and oceanic control methods. In the near term, DoD will use satellite based navigation systems to supplement today's inertial navigation systems. Satellite-based communications will be also the primary means for voice position reports. Cockpit display of traffic information, used in conjunction with satellite-based navigation systems, will allow more relaxed separation standards in oceanic airspace.

The service provider's role in developing daily oceanic tracks will change in the near future. Full surveillance, better navigation tools, real-time communications and automated data exchange between the pilot and service provider via data link facilitate the transition away from tracks and toward trajectories in oceanic airspace. The airspace structure may change dynamically based on weather, demand and user preferences. Dynamic routing for individual user-preferred trajectories will be the norm; oceanic fixed routes will be eliminated. Service providers, aided by supporting automation and electronic visual displays, will be able to acquire and view timely and reliable flight information to dynamically address necessary changes to the airspace or trajectories. Automation and procedural changes will help service providers to be more strategic in solving potential conflicts, traffic congestion, and demand for user preferred trajectories. Adjustments will need to be made to the airspace structure and/or trajectories when demand exceeds capacity. These changes will be coordinated with all affected national and international traffic flow service providers via electronic data transfer.

Handling of UAVs, ELVs, and RLVs - The majority of launches occur from U.S. launch bases and ranges. The FAA provides traffic management and separation assurance to vehicles as they transition through the NAS to and from space. ELVs and RLVs utilize airspace volumes that are dynamically reserved and released to allow the vehicles to transition through the NAS from sites other than the federal launch bases and ranges. The reserved airspace volumes are selected based on performance characteristics of the vehicle and overall safety considerations. The airspace volumes are tailored as mission needs or NAS needs dictate, in order to provide more flexibility than today's SUA.

5.3.8 Airspace Management Enhancement Area

It is important to remember that the current NAS continues to reflect its origins as a system in which aircraft flew directly between navigational aids along FAA defined routes. As a result, the current NAS airspace structure reflects constraints that the navigation, communications, and computer systems impose. To meet the emerging user needs for greater flexibility in planning and conducting flight operations, the air traffic system must evolve in the areas of airspace and procedures, roles and responsibilities, equipment, and automation.

Airspace Management Enhancement Operational Description

For future requirements to be satisfied, pilot and controller airspace management services must be enhanced. These services will be enhanced through the use of improved weather radars, advanced conflict detection and prediction systems, new avionics such as ADS-B and multi-function displays, and the implementation of decision support tools both on-board the aircraft and in the ATC automation system. In addition, airspace management enhancements will be required to accommodate new classes of vehicles: the Tilt Rotor, UAV, RLV, and ELV. The following paragraphs provide a description of the airspace management enhancements in the terminal area, in en route airspace, oceanic airspace, with separate paragraphs for enhancements to accommodate Tilt Rotor and UAV/RLV/ELV.

Terminal Area - Service providers currently use predetermined routes to manage departure flows. In the near future, more flexible departure routes are possible, within environmental constraints, as more aircraft are equipped with advanced navigation systems, and the service provider has automated support to verify adherence to the selected profile. These flexible paths comprise a large set of profiles from which the user may choose; however, individually coordinated user-preferred trajectories may also be used. Advance coordination of planned departure routes during the pre-flight phase will help make more flexible routing possible. In the future, decision support systems will assist the service provider to assign runways and merge/sequence traffic, based on accurate traffic projections and user preferences. These systems will eliminate today's need for comparatively rigid routing and airspace constraints that limit user flexibility. Tools such as FMS, data link, and satellite navigation will allow enhanced route flexibility by reducing voice communications and increasing navigational precision. The current ground-based navigation systems are in transition to satellite-based systems. The terminal airspace will be modified to implement new procedures for distributing arrival and departure waypoints, effectively reducing the level of congestion currently experienced at larger airports. IFR and VFR transition routes will be incorporated into the traffic-flow patterns in some terminal areas, which will reduce re-routing around the terminal area. GA aircraft transitioning outside these corridors will be afforded the use of unused terminal airspace as traffic allows. For sudden or unexpected reductions in airport arrival rates, traditional airborne holdings continue to be used.

To provide as much flexibility as possible in arriving and departing the terminal area, the pilot will be able to select which route he wishes to follow. In high-density terminal-areas, airspace design will allow for multiple arrival and departure routes based on area navigation. Routes in use will be sent via data link to pilots in properly equipped aircraft. This information will be exchanged with ATC and used in terminal-area decision support systems to provide appropriate sequencing. This flexibility, coupled with the on-board capabilities will allow pilots to fly to meet required times of arrival, thereby improving the use of airport assets. In addition, properly equipped aircraft will receive more user-preferred routings and departures and take advantage of the elimination of the 250 knots restriction below 10,000 feet Mean Sea Level (MSL) rule and will be authorized for lower RVR operations than those that are not equipped.

Departure and arrival route structures will be expanded, within environmental constraints, to allow increased usage of RNAV, satellite navigation, and routes flown automatically by the onboard FMS. All dynamic airspace configurations are limited to a finite number of major variations. Aircraft arriving and departing satellite airports in and around terminal areas remain clear of the primary airport's arrival and departure routes. Within each terminal area, there are predefined overflight area navigation (RNAV) routes that also avoid the primary airport's arrival and departure routes. The routes are not straight-line paths in situations where primary airport arrival and departure routes dictate otherwise.

When the projected demand for airspace is at or near capacity and after collaboration between users and national TFM, a temporary route structure with transition points for moving to and from user trajectories is identified. Static route structures exist only in places of continuous high density or to provide for avoidance of terrain and active SUA. Airspace will be managed collaboratively.

Separation standards may vary depending on equipage and the quality of positional data for individual flights. The delegation of authority for separation assurance is supported by the development of procedures, "rules of the air" that clearly define the parameters in which the aircraft and ground are operating without recourse to aircraft-to-aircraft negotiations for every situation.

En Route Environment – In the future, en route flights will routinely operate on user-preferred en route trajectories, with fewer aircraft constrained to a fixed route structure. These trajectories are accommodated earlier in the flight and continue closer to the destination than is currently allowed. As ground based navigation aids phase out with the continued transition to satellite navigation, the current route structure will be replaced with a global grid of named locations. These defined points will be used for coordination purposes, including transition points for flow initiatives, and as backup in the case of either airborne or ground based automation failures. Structured routes will be the exception rather than the rule, and will exist only when required to meet continuous high density, to provide for the avoidance of terrain and active SUAs, and to facilitate the transition between areas with differing separation standards. Static route structures will still exist only when necessary as in places of continuous high density, to provide for avoidance of terrain and active SUAs, and for transition between areas with differing separation standards. In addition, Reduced Vertical Separation Minima (RVSM) will change vertical separation above FL290 from 2,000 feet to 1,000 feet altitude increments. This will increase airspace capacity and allow for more users to fly at optimal altitudes. Reduced horizontal separation standards in the form of time-based separation will also provide additional capacity. With the potential for reduced vertical separation minima and additional available altitudes, the en route decision support systems will allow more aircraft to operate on routes according to the most favorable winds. The airspace structure will frequently be evaluated and adjusted in anticipation of expected traffic flows, or in response to weather and NAS infrastructure changes. Additionally, facility boundaries will be adjusted to accommodate dynamic changes in traffic. Static restrictions due to fixed sector boundaries will be reduced or eliminated.

The en route system automation will support the more flexible airspace structure and reduced sector boundary restrictions. With the reduction of the computational and communications barriers of the past, airspace design and underlying sector configurations are no longer constrained by the current geographic boundaries, particularly at high altitude. Automation systems support the dynamic airspace structure with seamless inter- and intra-facility communication and coordination that enables airspace structure flexibility and reduced boundary restrictions. The availability of ground-based conflict probe will allow the use of more flexible routes and altitudes. Increased collaboration between the airline AOC and the ATM system will occur as the AOC interactively probes proposed route changes. Modified routes will be developed collaboratively between the AOC and the service provider and then data linked to the cockpit and downstream ATC facilities. As a result of this automation, the traffic flow service provider's role will change to include coordination of dynamic airspace structuring, more strategic management of traffic, coordination of new trajectories, and the management of major flows.

The high altitude airspace structure has laterally defined sectors that encompass much larger areas, within a Center or even to include multiple Centers. In this new airspace structure, controllers have more room to laterally maneuver aircraft, which reduces coordination requirements. The airspace accommodates prevailing traffic patterns and considers the traffic activity and kinds of flight operations within the sector (e.g., instantaneous traffic count, proportions of flights that are climbing, at cruise altitude, or descending, and the direction of the flow of the traffic).

Upon completion of the National Airspace Review, tools and procedures are in place for frequent evaluation (i.e., up to several times a day) of the airspace structure and anticipated traffic flows, with adjustments to sector boundaries made accordingly. Due to this increased flexibility, the number and tasking of air traffic facilities may be modified to support dynamic traffic factors, rather than institutional requirements.

As in the departure and arrival phase, the service provider will have access to the SWIMS, which includes weather information, infrastructure status, and other conditions in the NAS. The provider will also have access to a predicted demand profile for the entire day. The profile is produced through improved information sharing, collaborative decision making, and the projection of flows based on weather and wind patterns. This information is used, in coordination with the national flow management and other en route traffic flow facilities, to determine the daily airspace structure. The ATSP will provide a temporary route structure, with transition points for moving to and from user trajectories, when the projected demand for volumes of airspace is at or near capacity.

The use of the SWIMS and the flight object means that any changes in the NAS airspace structure, including activation of SUA or the need to create temporary route structures, will ripple back through the information system and identify all flights whose trajectories penetrate the changed airspace. This will allow earlier and immediate coordination with either the pilot or the airline operations center to provide adjustments with minimal intervention and movement. Traffic flow service providers will work with the service provider in active communication with the pilot to re-plan the flight trajectory. Modified trajectories will also be developed collaboratively with the airline operations center and distributed to the flight deck via data link, and to downstream facilities via the SWIMS.

There are still times when projected airspace demand is at or near capacity. In these instances, after collaboration between the users and traffic management, temporary routes and associated transition points will be identified using the global location grid. Systems and procedures for creating temporary routes, and then using this gridded en route structure will have been addressed. The temporary route structure that prevails at a given time will be available to all service providers and users via the SWIMS.

Separation standards may vary depending on equipage and the quality of positional data for individual flights. The delegation of authority for separation assurance is supported by the development of procedures, "rules of the air" that clearly define the parameters in which the aircraft and ground are operating without recourse to aircraft-to-aircraft negotiations for every situation.

The ATSP will implement procedural changes to enable low altitude direct routes, greatly benefiting regional, business, general aviation and other users of airplanes and powered lift vehicles that need to operate in this regime.

Oceanic Environment – The greatest percentage of increase in air traffic is projected to occur across the Atlantic and Pacific Oceans. To accommodate this growth, improvements in navigation, communication and the use of surveillance are paramount enablers of capacity enhancement in oceanic airspace. Additionally, procedural reductions in separation standards are facilitated through the improved infrastructure. Automation and procedural changes will help service providers to be more strategic in solving potential conflicts, traffic congestion, and demand for user preferred trajectories. Oceanic separation minima in the vertical, longitudinal and lateral axes will be significantly reduced, allowing a corresponding increase in traffic demand. Separation standards may vary depending on equipage and the quality of positional data for individual flights. Delegation of authority for separation assurance is supported by the development of procedures, "rules of the air" that clearly define the parameters in which the aircraft and ground are operating without recourse to aircraft-to-aircraft negotiations for every situation.

The oceanic environment closely resembles the domestic en route environment in terms of waypoints, surveillance, airspace structure, and communications. Operational gains will be accomplished by allowing oceanic aircraft to laterally pass other aircraft at the same altitude by establishing an aircraft offset track. Route and airspace flexibility will be achieved as oceanic airspace is integrated into the global grid of named locations. This flexibility will be maximized through seamless coordination within and between facilities. Oceanic fixed routes will be eliminated. User-preferred routes replace the oceanic track system. Dynamic routing for individual user-preferred trajectories will be the norm

Improved flexibility in trans-ocean flights will be accomplished by increasing the choice of user operating altitudes. NAS Oceanic airspace will be standardized to other NAS-ICAO oceanic systems. Data will be presented to service providers in all oceanic systems in a similar format, thus minimizing translation by the provider.

The service provider’s role in developing daily oceanic tracks will change in the future. Full surveillance, better navigation tools, real-time communications and automated data exchange between the pilot and service provider via data link facilitate the transition away from tracks and toward trajectories in oceanic airspace. A trajectories-based airspace structure that may change dynamically based on weather, demand, and user preferences. Automated support to produce this flexible oceanic airspace structure will be in place. These changes will be coordinated with all affected national and international traffic flow service providers via electronic data transfer. Service providers, aided by supporting automation and electronic visual displays, will be able to acquire and view timely and reliable flight information to dynamically address necessary changes to the airspace or trajectories.

NAS oceanic service providers will coordinate with their oceanic neighbors to agree on a common set of rules and operational procedures for a harmonized oceanic system, meeting the challenge of international collaboration in day-to-day activities. Procedures for flight planning in US domestic and oceanic airspace will be identical in the future. Flight planning into non-US airspace will also evolve in concert with ICAO procedures.

Adjustments will need to be made to the airspace structure and/or trajectories when demand exceeds capacity. In oceanic airspace, these changes will be coordinated with national and international traffic flow service providers. The service provider will have access to the SWIMS as well as projected demand for the day. The NAS service provider will collaborate with international service providers to determine the daily airspace structure, identify and explore alternatives to potential capacity problems, and manage traffic over fixes including gateway entries.

Tilt Rotor Operations - Specialized users begin operating tilt-rotor craft having unconventional transition states that place them in a category between helicopters and fixed wing. In the initial years of operation, tilt-rotor craft operations tend to be few, localized, and follow traditional traffic flow. But as additional commercial uses are found for these vehicles, new operational regulations capitalize on their inherent capabilities. There are tilt rotorcraft using non-runway facilities and transition procedures from slow-speed vertical to higher-speed horizontal flight.

UAV/RLV/ELV Operations - The future NAS is intended to have increased unmanned aerial vehicles and space launch and re-entry operations. These types of operations will require the ability to activate and deactivate SUA in real time for the purpose of keeping UAVs and RLVs and domestic flight operations separate. SUA reservations are based on the characteristics of the vehicles and the priority of the use.

Space transportation users request ALTRVs, or temporary, geographical, special use airspace from surface to unlimited. ALTRVs are filed through the CARF. Control of scheduling and flight planning rests with the DoD for operations from federal launch ranges. Commercial users exercise control of scheduling and flight planning from non-federal launch sites.

There are space launch/reentry sites at coastal, inland, and sea-based locations. As a result, a variety of space vehicles operate in the NAS. These vehicles include traditional ELVs that operate predominantly from U.S. federal launch ranges, and RLVs that operate from a variety of launch/reentry sites around the country. ELV and RLV operations utilize various types of ATC clearances, as determined by vehicle characteristics such as mode of launch and reentry, pilot technique, avionics equipage, trajectory predictability, etc. Vehicles that perform comparably to conventional aircraft may be handled in manner similar to those aircraft. Traditional ELVs require dynamically reserved airspace to provide separation assurance.

Space vehicles operate at dual-use facilities handling both aviation and space operations as well as at dedicated spaceports that are established within high density terminal airspace. Dedicated launch/reentry sites are established within high density terminal airspace. Space vehicles operate in accordance with the same surveillance and control techniques used for conventional aircraft. Space vehicle flight restrictions, due to traffic, are matched to the inherent constraints of the mission/vehicle.

Departing and arriving space missions are time-constrained by strict launch and reentry windows, and are by factors such as feasible alternate landing facilities.

The majority of launches occur from U.S. launch bases and ranges. The FAA provides traffic management and separation assurance to vehicles as they transition through the NAS to and from space. ELVs and RLVs utilize airspace volumes that are dynamically reserved and released to allow the vehicles to transition through the NAS from sites other than the federal launch bases and ranges. The reserved airspace volumes are selected based on performance characteristics of the vehicle and overall safety considerations. The airspace volumes are tailored as mission needs or NAS needs dictate, in order to provide more flexibility than today's SUA.

The SWIMS enables domestic and international users and service providers to access most space mission profiles and associated SUA data.

The operation of UAVs begin. These are unconventional airborne vehicles that are operated via data link by personnel situated in a ground facility. They perform special missions (especially DoD and other government agency airborne surveillance) that generally do not interact with the air traffic system. Because these vehicles are unmanned, there are special airspace and navigation procedures that allow for limited operation in the NAS. These procedures tend to be by exception, at first, and are locally coordinated between the Center/Sector and the UAV operator.

RLVs are developed and operate at various launch and reentry locations in the NAS. Some RLVs have operational characteristics similar to conventional aircraft and use dynamically defined route structures to facilitate transition to and from space. Depending on the mission and vehicle profile, these routes are used in conjunction with reserved airspace volumes to segregate different types of missions, to concurrently accommodate different mission phases (e.g., launches vs. re-entries), and to ensure safety in case of contingencies.

5.3.9 Emergency and Alerting Enhancement Area

Emergency alerting enhancements will be characterized by improved Emergency Locator Transmitters (ELTs) and improved flight following services for VFR traffic.

Emergency and Alerting Enhancement Operational Description

For future requirements to be satisfied, pilot and controller emergency and alerting services must be enhanced. These services will be enhanced through the use of improved ELTs, enhanced DF, and flight following services.

Improved ELTs will be in use with corresponding new standards and rulemaking. These ELTs will utilize discreet codes and satellite based navigation positioning information to aid in search and rescue. For aircraft equipped with these systems, the SWIMS will either identify the successful completion of the flight or provide its last known position. For search and rescue, ELTs must transmit the aircraft's last known position to the SWIMS. When a flight is overdue and no ELT signal is detected, the flight's information will be readily available to search and rescue organizations through the SWIMS to verify the need to initiate search procedures.

At the current time, many GA aircraft, both low and high end are equipping with RNAV systems based on GPS in addition to the conventional navigation suite which includes Automatic Direction Finder (ADF), VOR/DME and ILS. High-end GA aircraft are frequently equipped with inertial navigation and Flight Management Systems. Direction Finder (DF) services are provided if the pilot is lost, the pilot requests the service, or the advisor suggests the service and the pilot concurs. DF may be provided to lost aircraft by either single- or multi-facility DF services.

The availability of flight data for all flights via the SWIMS will improve the ability of the service provider to issue traffic advisories to controlled aircraft about uncontrolled aircraft. There will also be improved flight following services for VFR traffic. For VFR aircraft automatically reporting their satellite-derived positions, the inclusion of that information, coupled with access to the flight's data via the SWIMS, will reduce the workload associated with providing traffic advisories to uncontrolled aircraft. These tools aid in preventing controlled aircraft from entering restricted airspace and aircraft crossing Air Defense boundaries are reported to the appropriate military entity.

There are no applications being developed for the Emergency Alerting Enhancement Area.

5.3.10 Infrastructure/Information Management Enhancement Area

This Enhancement Area refers to the management of NAS equipment, facilities, systems, and the services they provide. Managing services ultimately relies on managing systems and their component elements. NAS infrastructure services include communications, navigation, surveillance, weather, decision support, and environmental services. Some infrastructure services such as navigation and landing signals, and aeronautical information broadcasts are provided directly to FAA customers. Other services are provided from one FAA organization to another.

The overriding objective of NAS Infrastructure/Information Management is to enhance the efficiency and effectiveness of NAS infrastructure service delivery. Fundamental to the management concept is the belief that effective service must be provided on the basis of user priorities through shared information and decision-making. Infrastructure operations and maintenance (O&M) will be performed from the viewpoint of customer requirements for the services, with an understanding of the effects of O&M activities on service delivery to NAS infrastructure users. Close collaboration with infrastructure users will ensure that the right service and priority is applied to service delivery. Infrastructure operations will be performed from a national perspective. This approach ensures that uniform, nationwide procedures are applied and infrastructure activities managed on a broad view basis of impact across the NAS.

Infrastructure/Information Management Enhancement Operational Description

New Infrastructure Management Technology - The availability of new technology provides opportunities for major technology infusion to enhance infrastructure management. Innovative ways of managing the NAS infrastructure will emerge from new computing and communications capabilities, increased equipment and system self-monitoring and self-restoration, enhanced networking, and expanded use of remote monitoring and control.

New CNS Infrastructure - In the future, surveillance will be accomplished through a combination of primary radar, beacon interrogation, and broadcasts of aircraft position and speed. As more forms of position data become available, more traffic will be under some form of surveillance. An increasing number of aircraft will be equipped with satellite-based navigation, digital communications, and the capability to automatically transmit position data. Many of these aircraft have this capability coupled to an FMS. FMS equipage, including coupled navigation capabilities, will also allow for more efficient flight planning by the AOC. Additional intent and aircraft performance data will be provided to decision support systems, thus improving the accuracy of trajectory predictions. This information will be combined and presented on the service provider's display. In addition, the use of paper flight strips will be phased out since decision support systems will display the necessary information to the ATSP.

Routine communications will be increasingly handled by data link. Most en route communication and reporting will be done via data link, which will lead to faster frequency changes and transfer of communication as well as more reliable communications and faster clearance delivery. Updated charts, current weather, SUA status, and other required data will be up-linked (or data-loaded) to the cockpit allowing for better strategic and tactical route and altitude planning. Data link will also allow the aircraft crews and the service provider specialists to see the same weather and alerts. In addition, basic flight information services will be available via data link to those aircraft that are properly equipped. This information includes current and forecast weather, NOTAMs, and hazardous weather warnings. Additionally, more aircraft provide real-time winds and temperatures aloft, resulting in better weather information for forecasting and traffic planning. Weather data will be distributed to decision support systems for processing and presentation to service providers, resulting in a more accurate and common awareness of meteorological conditions.

The pilot will have better downstream weather data information in digital form, both through automated means and through request/reply data link. A pilot will be able to obtain weather forecasts for not only the specific areas through which the aircraft will pass, but also the specific time at which the aircraft will pass through that area. More aircraft will provide real-time winds and temperatures aloft, resulting in better weather information for forecasting and traffic planning. Weather data will be distributed to decision support systems for processing and presentation to service providers, resulting in a more accurate and common awareness of meteorological conditions. Satellite-based surveillance systems that enable robust multi-function capabilities will begin to appear in GA cockpits.

The greatest percentage of increase in air traffic is projected to occur across the Atlantic and Pacific Oceans. To accommodate this growth, improvements in navigation, communication and the use of surveillance are paramount enablers of capacity enhancement in oceanic airspace. Additionally, procedural reductions in separation standards are facilitated through the improved infrastructure. Automation and procedural changes will help service providers to be more strategic in solving potential conflicts, traffic congestion, and demand for user preferred trajectories. Oceanic separation minima will be significantly reduced, allowing a corresponding increase in traffic demand.

New advancements in ATC DSTs, data link communications, surveillance, and navigation will facilitate merging domestic en route and oceanic control methods. Full surveillance, better navigation tools, real-time communications and automated data exchange between the pilot and service provider via data link will facilitate the transition away from tracks and toward trajectories in oceanic airspace. The airspace structure may change dynamically based on weather, demand and user preferences. Adjustments will need to be made to the airspace structure and/or trajectories when demand exceeds capacity. In oceanic airspace, these changes will be coordinated with national and international traffic flow service providers. The combination of satellite-based communications and electronic message routing will enable the oceanic system to be more interactive and dynamic, supporting cooperative activities among flight crews, AOCs, and service providers.

In the future, the oceanic service provider will have access to the SWIMS as well as projected demand for the day. Service providers will use visual displays to monitor the traffic situation. Advanced oceanic weather detection capabilities and integration into automation systems will provide better situational awareness. The oceanic service provider will also benefit from use of the same type of decision support tools available to help en route service providers. Such tools will aid in detecting and resolving possible conflicts, and preventing controlled aircraft from entering restricted airspace. Aircraft crossing Air Defense boundaries are reported to the appropriate military entity. The integration of the military into the oceanic communications system to facilitate automatic reporting will be in place. Coordination and exchange of information between sectors will be automated to increase productivity and efficiency of service providers.

The airlines' oceanic aircraft fleets tend to be fully equipped with the latest avionics for communication, navigation, and surveillance due to the long duration oceanic flights as well as the lack of ground-based infrastructure. Many aircraft currently are FANS-1 equipped or have the required navigation performance capability for reduced separation standards.

In the future, the characteristics of oceanic operations will include the following:

- Improved inter- and intra-communications among air traffic service providers and NAS users facilities exchange of information and increases productivity and efficiency.

- A harmonized NAS-ICAO oceanic system where data will be presented to the oceanic service provider in the same or a similar format, minimizing translation on the part of the provider.
- Procedures for flight planning in US domestic and oceanic airspace are identical.
- Any changes made to the NAS portion of oceanic airspace will be coordinated through ICAO. Coordination and information exchange between adjacent flight information regions (FIR) will be provided by interfacility data communications.
- International communications standards for data will be established.
- A capability for secure-encryption data link of weather and air traffic management information to accommodate DoD user needs will be available.
- Collaboration with international service providers to determine the daily airspace structure, identify and explore alternatives to potential capacity problems, and manage traffic over fixes, including gateway entries.
- The international communications structure and protocols necessary for this coordination/ collaboration will have been developed.

New Infrastructure Monitoring and Control - Full-time monitoring and control of NAS infrastructure service delivery and systems functioning will be provided for efficient service and systems management. Remote monitoring and control will be increasingly used to enhance timeliness of response to infrastructure user needs, and increase efficiency in the use of field personnel. It will also be used to remotely collect and process status information from NAS infrastructure resource, define authorized users, and establish access control to the commands.

Through the SWIMS, service providers will also remain informed on distant weather conditions in order to anticipate changes to the daily traffic flow, and requests from other facilities. Data from the SWIMS will allow service providers to monitor infrastructure status, staffing, and other conditions in order to anticipate traffic demand and workload, both at their own facility and at others. This is especially important when working with tower service providers to manage runway configuration changes.

New Management Methods - The new technologies, however, also require new management methods and operations processes to capitalize on the opportunities. NAS modeling will be used to define relationships between NAS elements, associate a criticality level to each resource, and provide tools to maintain a database of the relationships.

Event Management will be used to classify and type events, and track NAS maintenance activities. New information management processes will be put in place to achieve coordination across organizations, domains, and systems. NAS infrastructure management support functions will be used to log, archive, and analyze NAS infrastructure management tool operational data. System management activities will be effectively performed by a prioritization scheme and responsiveness based on service performance needs. Fault Management will be used to generate alarms and alerts and manage actions to resolve the events that caused the alarms. Security Management will be used to protect a NAS infrastructure management tool data via user identification, authentication, and access control mechanisms; support NAS-wide security management, such as detecting and logging NAS infrastructure security violations for reporting to FAA management. Maintenance Management will be used to match available maintenance resources with tasks that need to be completed. Support Resource Management will be used to maintain information on the status of all resources required to support the NAS.

General management of the allocated aeronautical frequencies will be provided and technological developments, which contribute to the more efficient use of these frequencies, will be supported.

NAS infrastructure assets are assigned/reassigned dynamically to mitigate infrastructure problems as well as in response to changes to in sectorization and airspace assignment. All major equipment-replacement schedules will be monitored to ensure that no two adjacent facilities will be vulnerable at the same time. All NAS resources are registered in the Common Reference System, and monitored and managed through the SWIMS. A common Geographical Information System (GIS) format is used to store all NAS information including terrain, obstacle, weather, and navigation, surveillance and communication coverage information. This information is available via the SWIMS to all service providers and users. Operations management will shift to a paradigm where managers have local control over resources, and use an automated information management system to access and analyze data.

To promote efficiency of the services, the roles and responsibilities of managers will change. Some of these changes include:

- Management resources such as training, administration support and labor relations are pooled across organizational boundaries for an equitable distribution.
- In order to make the operation efficient and successful, one facility manager is accountable for the air traffic services run at the respective field unit and the infrastructure management support that makes the operations possible.
- Operational managers work autonomously, with less management oversight from outside the facility.
- Managers have the necessary fiscal and personnel resources to accomplish their mission, and the authority to allocate resources as needed.

To support the new demands on managers, appropriate training is provided to ensure that managers have the necessary knowledge, skills, and abilities to perform the range of management tasks and decision-making activities expected.

New Management Information Systems - A management information system will provide automated access to management data about NAS operations and infrastructure. It integrates with a decision support system to aid in managing the budget, personnel and operations. It will also provide access to a database integrated with executive decision support tools for managing the budget and analyzing the cost of operations. Information such as cost of operating the facility, personnel and overhead costs, overtime, labor-management relations, and adherence to schedules can be extracted. Based on the analyses, the manager can make educated decisions about resource allocation and operational efficiency. Business operations will be more effectively managed and monitored by easy access to, and analysis of data through a management information system. The management information system is national in scope, providing information about the operations of all FAA operational facilities. This will allow managers to benchmark their operations against other facilities, and allows the FAA to understand and compare the operational and fiscal efficiency of all facilities.

Increased Information Exchange and SWIMS - Information management is a critical component of traffic management. Improved information exchange among users and service providers enables shared insight about weather, demand, and capacity conditions and allows for improved understanding of NAS status and TFM initiatives. Users and service providers alike will begin to experience the benefits of increased automated exchange of information between users and service providers. Timely and consistent information across the NAS will be made available for both user and service provider planning purposes. Databases and decision support systems that use these databases enable a shared view of traffic and weather among all parties so that proposed strategies can be evaluated. For example, in a severe weather situation, increased collaboration among users and service providers enables shared decisions on how to avoid the severe weather and deal with the resultant short-term capacity shortage.

The SWIMS will makes information available to all service providers for a common understanding of situations. Hence, they can collaboratively plan strategies that are not only more responsive to the situation, but also consider the needs of the entire NAS. In the future, users will be better able to plan their flight operations in anticipation of NAS capacity and traffic conditions, and to minimize congestion or possible delays due to the comprehensive information made available by the SWIMS. This system will include up-to-date information such as capacity and aggregate demand at airports and other NAS resources, airport field conditions, traffic management initiatives in effect, and Special Use Airspace status. There are two major inputs from the SWIMS. The first is aeronautical and weather data and the second is aircraft tracks from the local TRACON. Service providers at the ATCSCC will develop a NAS-wide understanding of conditions, capacity, and traffic flow to serve as a central point-of-contact for NAS users and local service providers. These service providers will develop a composite understanding of NAS weather and capacity conditions and make appropriate updates to the SWIMS. They use the SWIMS to manage information about current and predicted NAS conditions as well as past performance.

As in the departure and arrival phase, the service provider will have access to the SWIMS, which includes weather information, infrastructure status, and other conditions in the NAS. The provider will also have access to a predicted demand profile for the entire day via the continually updated SWIMS. More accurate NAS information via the SWIMS, together with improved automation (ground and air) will enable user-preferred routes that will be routinely flown with a minimum of rerouting. The availability of flight data for all flights via the SWIMS will improve the ability of the service provider to issue traffic advisories to controlled aircraft about uncontrolled aircraft. The activation of a SUA results in the re-evaluation of all flight trajectories in the SWIMS, to determine which flights will penetrate the SUA. There will also be improved flight following services for VFR traffic. For VFR aircraft automatically reporting their satellite-derived positions, the inclusion of that information, coupled with access to the flight's data via the SWIMS, will reduce the workload associated with providing traffic advisories to uncontrolled aircraft.

Improved Weather Information and Tools - With the improved accuracy and display of the weather information on the service provider's display, a common understanding of significant weather will be shared by user and provider, thereby enhancing safety and supporting collaborative decision making. In order to make these capabilities a reality, widespread integration of weather data into automation and the SWIMS. will be necessary. Improved weather tools and displays will be used to assess the effect of weather on departure and arrival airspace capacity. In addition, the service provider will have improved tools to assist pilots in avoiding hazardous weather, special use airspace, and terrain/obstructions. Enhanced weather data and weather alerts will be output on service provider displays, and simultaneously uplinked for display on the flight deck. These displays will improve the service provider's ability to coordinate with the flight deck and with other service providers to ensure the avoidance of hazardous weather. However, some users will be equipped with cockpit-based terrain and airspace displays that enhance their ability to avoid hazardous airspace and terrain.

Information Security - Information security is integral to the NAS architecture. While not an obvious contribution to NAS functionality, information security is essential to ensuring the availability, integrity, and confidentiality of NAS operations. To protect NAS systems, information security must be engineered so that NAS functional performance and cost tradeoffs include appropriate protection whenever sensitive systems are involved. This management structure will administer security processes from an operational viewpoint and participate during the acquisition phase of the life cycle. A system wide concept of operations for information security ensures uniform security measures within individual systems and compatibility across systems. Users must have confidence in the data they access and confidence that sensitive or proprietary data they provide will be protected.

Handling UAVs/ELVs/RLVs - New range automation technology is used to coordinate space vehicle flight profiles in support of launch and reentry activities. Shared access to all commercial space operations schedules is provided via the SWIMS. Military space operations schedules are also available to selected service providers based on security requirements. This integrated set of schedules allows mission planners to synchronize their operations and mission support services. The schedules also provide the service provider with a global view of the projected demand generated from space operations.

Space vehicles operate from dual use facilities that accommodate both aviation and launch/reentry operations. As 'space planes' are developed, they begin to operate at joint-use facilities handling both aviation and space operations, as well as at dedicated spaceports that are established within high density terminal airspace. Space vehicle flight profiles are developed that accommodate user priorities while being sensitive to flow conditions and constraints. The SWIMS enables domestic and international users and service providers to access most space mission profiles and associated SUA data.

Space vehicles operate from an increased number of coastal, inland, island, and sea-based locations, and recovery operations are increasingly common. As radar-like surveillance and direct communications become available in oceanic airspace, space vehicles utilize the same general capabilities in oceanic airspace as used in the en route environment.

5.4 Users/Affected Personnel

Table 2 identifies all potential users or involved personnel, based upon future NAS operations. It is identical to Table 1. The users involved before and after changes to the NAS are the same. Their roles and responsibilities change in accordance with the preceding discussion.

5.5 Support Strategy

To be determined

Table 2. Users or Personnel Involved in Future NAS Operations

Users or Involved Personnel	Future Operations
Traffic Management Specialist at Air Traffic Control System Command Center (ATCSCC)	✓
Air Traffic Control Supervisor (ATCS)	✓
Supervisory Traffic Management Coordinator-in-Charge (STMCIC)	✓
Operations Supervisors (OS)	✓
Traffic Management Coordinator (TMC)	✓
En Route Radar Position – R controller	✓
En Route Radar Associate (RA) – D controller	✓
En Route Radar Coordinator (RC)	✓
En Route Radar Flight Data (FD) Position	✓
En Route Non Radar (NR) Position	✓
Terminal Radar Position – R controller	✓
Terminal Radar Associate (RA) – D controller	✓
Terminal Radar Coordinator (RC)	✓
Terminal Radar Flight Data (FD) Position	✓
Terminal Non Radar (NR) Position	✓
Tower Local Controller (LC)	✓
Tower Ground Controller (GC)	✓
Tower Associate	✓
Tower Coordinator	✓
Tower Flight Data Position	✓
Tower Clearance Delivery Position	✓
Flight Service Station Specialist (FSSS)	✓
Airline or Aircraft Flight Operations Center (AOC)	✓
Pilot or Flight Crew (FC)	✓

6. Operational Scenarios

Because of the uncertainty in the actual implementation of the operational concept described above there are many possible scenarios that can be developed to describe future operations. The Air Traffic Management Operational Concept Panel (ATMCP) - Ninth Meeting of the Working Group Of The Whole, August 20 - September 6, 2002, (Reference 21), has formulated the following potential scenario of future ATM operations.

Context

The flight is a commercial flight, belonging to a large airline. The airports/aircraft are equipped as follows:

Departure	Arrival
Equipped with datalink	Equipped with datalink
Equipped with decision support	Equipped with decision support
Capable of all-weather operations	Capable of all-weather operations
Situated in a high traffic volume arrival/departure complex	Situated in a medium-sized, medium complexity traffic volume arrival/departure complex

Pre-Flight Phase

The flight is going through final planning. The AOC has submitted the user preferred profile and it is being coordinated with the system flight planning function which provides feed-back on weather along the preferred trajectory, any current constraints in the airspace as well as expected traffic volumes and potential for delay. A final flight profile is generated which accommodates the user preference for the flight to the degree possible given constraints.

This is not the system's first knowledge of the flight. Months early, the potential for the flight was provider by the airspace user to the ATM system to allow for strategic planning of resources and allocation of airspace for other uses. Based on the expected flow and the historically dominant weather/winds patterns, one portion of the airspace has allocated in the ATM system for a military exercise. This allocation was entered into the service provider's master AOM database and is available graphically, in text format, as well as in a standard GIS format to any flight planning function supporting a user with a desire to access the airspace.

This master planning function has also provided the basis for the internal allocation of airspace to service providers. Using the major flows, the airspace for the day has been designed to minimize coordination among the providers as well as reducing the potential for conflicts occurring close to hand-off. With the master plan for the day, all assets are adjusted and automatically coordinated to best serve the plan. This adjustment includes airspace volumes as will as the CNS assets allocated to the volumes.

Unfortunately as the day of the flight arrives, the expected wind and weather environmental conditions have not occurred. Since ground assets had to be moved in place for monitoring the military exercise, the exercise airspace cannot be moved. Some modifications to the allocation are coordinated which allow the exercise to continue as planned while lessening the impact on individual flights and flow. This change is entered into the master AOM system and is available as an update to all who have registered in the system to revive information about this volume of airspace as well as in response to any new flight planning or activation actions. During the planning of the flight, the user preferred profile was adjusted through coordination to avoid the exercise area.

The changes in the environmental conditions have also been cause for re-evaluation of the airspace plan. Adjustments to service provider allocations can and are made being made. However since this is day of operations, the degree of flexibility available in months prior is not there and it is anticipated that an allocation of airspace to individual flights may occur later in the day to manage a demand over capacity problem.

Since the current projection of traffic volume for the morning is low, the system has not established any route structure to manage the flow in dense areas. The flight crew manages their flight information briefing by accessing the ATM system information network. The briefing can occur wherever they have access to SWIM including the flight deck. The briefing function provides access to the AOC, to the DCB traffic function and to ATM. Using the facilities, the flight-crew familiarizes themselves and agree (in co-operation with the AOC) with the details of the flight's coordinated (e.g., the actual and forecast weather conditions, the airspace structures in operation on their route and their planned push-back and departure times) profile. They also register an alternative profile that will utilize the military exercise airspace if it becomes available. The system allows the users to maintain alternative requests in the system for automatic coordination as conditions along the coordinated profile change.

There are no inherent differences in the manner in which an individual flight for a single user or a fleet is coordinated with ATM. Differences are only apparent at the fleet level where the AOC make trade-offs among the profile allocations of individual flights to meet a company objective.

The flight information will contain a much more comprehensive description of a flight's intentions than it does a current flight plan; principal changes will be in the quality and amount of data it holds and in the dynamic nature of its contents, such as:

- Route data will consist of 2D reference points in World Geodetic System-84 format (WGS-84), allied to a z (altitude or Flight Level) co-ordinate to give a 3D position (3D fix) and, for 4D flight, an associated time (4D fix). The number of 3D or 4D fixes and the level of accuracy required for a trajectory will be determined by the need to ensure effective planning and safety);
- The flight trajectory will be updated automatically in flight as necessary either whenever the actual versus previously projected fall sufficiently out of compliance. This can occur whenever an adjustment to the agreement on flight profile is made (avoiding action, trajectory alterations, re-routing etc.);
- More data on performance capabilities of the aircraft will be held, either on the ground or in the air, to allow for better trajectory prediction; and
- Other preference information such as expected gate/stand assignments, runway preference, etc is supplied for use by the strategic functions.

Ground Departure (Start-Up)

When all briefing activities are completed, the flight-crew board the aircraft and complete their pre-flight checks (including validation of the flight plan).

Note: The availability of datalink facilities between the aircraft and ATM allows for a considerable increase of efficiency in information exchange between the flight-crew and the ground. Information that would otherwise be impossible or very time-consuming to exchange by using voice communications or Radio Telephony (R/T). Datalink has safety and productivity benefits in its ability to transmit long or complicated messages very quickly. If desired, any messages, clearances or instructions passed to the flight-crew may be printed to reduce the potential problems of misunderstanding, mishearing or forgetting. In addition, with the flight-crew's authorization, complicated messages such as taxi route instructions can be loaded automatically.

The flight-crew will have been aiming for a coordinated start-up time where required by DCB. This time takes into account an approximate time for getting to the runway, but the vagaries in passenger loading and other activities mean that there are always elements of uncertainty about the precise time that a flight will be ready. However, once the passengers have boarded the aircraft, the baggage, fuel and catering supplies have been loaded and the ground-crew have cleared the aircraft for departure from the gate/stand, nearly all uncertainties have been removed.

The flight-crew next contact the ATM system to obtain their start-up and taxi clearances via R/T.

The ATM surface flow service provider, who has already received data about the flight from the ATM network, uses automated planning tools to assess all actual and known planned movements on the Airport so as to be able to decide the best start-up time and the most efficient taxi plan for the aircraft to meet its planned take-off time (a more accurate time than now). The tower provider passes the taxi plan (consisting of a time-scheduled route) by datalink and the start-up clearance by R/T to the aircraft.

Ground Departure (Taxi)

The flight-crew receive their start-up taxi-plan clearance and display their assigned route on the airport map data on their flight deck display. The display also provides the identity, position and short-term intentions of other maneuvering traffic (aircraft and vehicles) relevant to their flight. Each portion of the taxiway system is registered into a geographical information data base system. This functionality allows the system to manage the status of any portion of the taxiway and the flight deck display includes graphical representation of those portions of taxiway which are currently no available due to ongoing upgrade and repair. Since the flight deck is registered as a user of the ATM information network, the status of the ground infrastructure was also provided to the flight deck at clearance delivery. At the appointed time they start up, push-back and start to taxi on their assigned path along routes that have been designed to minimize or eliminate conflict between departure and arrival taxi streams and to ease potential queuing or congestion problems.

The weather is bad and the visibility is so poor that, using normal vision, the flight-crew can see nothing, or very little, outside the cockpit. They are assisted however, by flight deck systems that allows them to "see" in poor visibility, as well as giving them graphical representations of their surroundings Interference to schedules caused by bad visibility is minimized for equipped aircraft and, unless the weather conditions really become too bad for safe operations, the same level of throughput is achieved as in good visibility conditions.

Notes:

1. Of course, not all aircraft will have enhanced situational awareness systems on the flight deck. In some cases the service provider can assist the aircraft with taxiing. Using ground-based active and passive detection equipment on and around the Airport, the provider will be able to monitor all airport traffic, guide an aircraft to its destination and, using ground-based systems, to provide position and intention transmissions as though they were from the aircraft.
2. In the information-rich environment all agencies that are responsible for ground movements on the airport will have the same information on the identities, positions and intentions of flights on the maneuvering area as well as their own movements (vehicles and aircraft). This

will give the opportunity for responsibility for separation on the airport surface to be shared between ATC and ground agencies (aircraft maintenance, fuel companies etc.). Flight movements can be the responsibility of Tower and Runway providers and will have priority over all other movements (subject to safety) and the agencies will be responsible for coordinating their movements with the providers and to ensure that their vehicles and aircraft remain clear of the flights.

The flight-crew use the taxi plan so as to enable them to arrive at the holding point on time.

Note:

One benefit will be that the increased accuracy of aircraft movements will mean that adherence to expected/allocated departure timings will be improved. These slot assignments are made to manage order for runway use efficiency as well as any traffic synchronization requirements to improve arrival and departure flow. Also with the inclusion of surface into the full surveillance planning web, the future trajectory of the aircraft is updated and available for system planning effectively increasing the knowledge of an aircraft by the system.

Whilst the aircraft is taxiing, any refinements or changes that need to be made to the departure trajectory (either by the terminal provider, the AOC or the DCB facility) are coordinated by the system, and presented to the all including the flight crew via data link for review and acceptance.

<u>Ground Departure (Take-off)</u>

On arrival at the holding point the flight-crew confirm their readiness for take-off (by R/T) with the runway provider who, when appropriate, clears them to enter the runway and take-off (probably by R/T). The Runway provider is supported by active and passive detection systems to monitor the runway area, to guard against unauthorized runway incursions, to ensure adequate separation from other aircraft using the runway (wake vortex) so as to ensure that it is safe for the aircraft to enter the runway and take-off.

The flight-crew use their enhanced situation displays, including data from on-board and ground sources, to accurately maintain the runway centerline and to take-off (even in zero visibility conditions). Once airborne, the flight-crew makes contact with the provider who will be responsible for the flight.

Notes:

1. R/T frequency changes in the aircraft will be performed automatically.
2. Contact handshakes' between the aircraft and the ground as the flight moves from assigned provider to provider (now done manually and verbally by the flight-crew) will be performed automatically, initiated by handing-offs between providers and activated on the flight deck via data link . The flight-crew will be advised of the action.
3. Because the departure route or routing is established beforehand, there is no need for the flight-crew and provider to communicate with each other under normal conditions. Here, datalink assists both flight-crew and provider by making it possible for the passing of non time-critical messages and clearances to and from the flight to be made via datalink rather than R/T.
4. The departure route, passed to the aircraft before start-up, is one that is optimized as much as possible, during the coordination, for the benefit of the flight by matching the route as closely as possible to the performance capabilities of the aircraft and the wishes of the airline. The route takes into account other departure, arrival and transit flights and the weather.

5. In addition more flexibility will be gained by the ability to dynamically restructure airspace to respond to changing traffic flows during the course of the day. as well as the weather and environmental restrictions. The primary concerns will be to keep flights clear of hazards and to satisfy noise abatement requirements.

Climb-out Phase

The flight commences its optimized departure through the allocated departure airspace, in which, through the planning and dynamic response capabilities of the future ATM network, stepped climbs are eliminated or considerably reduced. In addition, the minimum separation standards will be reduced (subject to wake vortex considerations), enabling greater capacity whilst still maintaining acceptable safety levels, through:

- Increased aircraft navigational accuracy;
- The reliability and integrity of ground-based flight path prediction systems; and
- The ability to exchange flight intentions by datalink.

During the initial stages of the climb-out, either the flight-crew fly the aircraft manually with the aircraft's systems monitoring the flight's conformance to the approved trajectory (within set parameters), or the aircraft's systems guide the flight with the flight-crew monitoring its conformance. The flight-crew maintain their own situational awareness, assisted by traffic displays which enables the flight-crew to be aware of the identity, position and short-term intentions of other flights operating in the airspace and within their area of interest.

Notes:

1. Traffic data may be gathered either by air-air data exchange between the flights or by data transmitted to the flight from the ground. In addition, the use of ACAS provides a safety-net to help prevent collisions between flights.
2. The situation displays and all applicable "hazard" information will also be used when partial delegation of responsibility for some separation functions (in-trail climb, cross/climb when clear etc.) are transferred to the flight-crew by the controller.

As the flight exits the departure phase at its pre-arranged exit point and enters the En-Route phases, control of the flight and responsibility for separation is transferred to an En-route provider, again silently and with automatic R/T frequency changes.

Descent and Approach Phase

As the flight approaches its destination the flight-crews/AOC flight planning systems coordinate updates to the arrival trajectory with a ATM flight planning system. The TS systems have had access to all trajectory updates and use the updates, as well as gate/stand assignment and runway preferences to assess the current arrival sequence, identify surface movement interactions and determine any constraints that may need to be applied. Depending on the traffic density the constraints can range from:

- Designating a set trajectory for the flight to follow;
- Passing details of the planned and real-time approach/departures of other flights, but otherwise leaving trajectory selection to the flight (the on-board systems will have all permanent and temporary airspace restrictions data); and
- Coordinating a time and level for the flight to arrive at the initial point for final approach.

Note:

The methods of control and situational awareness for the flight-crew are the same as those in the Departure phase. However, a principal aim for arrivals management where traffic density is not a problem is to grant as much freedom of operation as possible to the user. If the traffic level is low therefore, there is no need to restrict aircraft trajectories except to ensure separation from other traffic, reserved airspace or for environmental concerns.

Regardless of the circumstances, the flight-crew the final arrival trajectory is coordinated and electronically exchanged. At the coordinated time, the flight begins descent in the initial stage of the approach. As in the climb-out, the flight-crew monitor and confirm that the aircraft's FMS is guiding the flight in conformance with its planned trajectory, use their situation displays to assist in maintaining their situational awareness and have airborne collision avoidance systems (ACAS) as a safety-net.

Note:

Once an arrival time for the flight has been established, the TS system uses the coordinated trajectory to determine the optimum taxi route for the aircraft to its gate/stand. Since all ground taxi segments are managed in a geographical database, any closed or unidirectional segments are available for planning. The ATM surface flow service provider reviews the taxi plan and it is up-linked to the flight.

As the flight descends through the arrival airspace, the flight-crew can see other flights in the airspace, either visually or via the situational awareness displays. To support the merging and spacing activities the service provider may offer the flight crew the opportunity to participate in cooperative separation or instruct the flight crew to meet a displacement in time and distance with other specified aircraft.

Ground Movement Arrival Phase

The flight completes its approach and landing on the runway. The TS system verifies the coordinated taxi-plan is still viable and preferred. If not, a new plan is generated and coordinated between service provider and flight deck with electronic transfer to the flight deck. Taxi from the runway to the gate/stand is the same process as that described for the ground departure phase.

Post-Flight Phase

The flight has reached its gate/stand, the engines spooled down, passengers and flight-crew departed and the ground services now ready the aircraft for its next flight. But that is not the end of the involvement of future ATM. The data from the flight are collated with all other data concerning it (e.g., from the flight planning, AOM, DCB, TS, CM) in order to be able to provide a comprehensive and authoritative source of data on all completed flights. This data will be used for a number of reasons. The principal aims are to:

- Evaluate actual against projected RASP performance;
- Improve mappings of RASP requirements to ATM investments;
- Improve historical data bases;
- Improve pre-planned ATM actions (AOM, DCB, TS) by evaluating and adjusting parameters, and
- Identify new ATM actions

7. Summary of Impacts

7.1 Operational Impacts

The major operational impact resulting from the future NAS operational concept is the changed roles for the ATSP and flight crew, both in terms of separation assurance and constraint conformance. These impacts along with some of the major future system operational characteristics and features have been described in some detail in Section 5.3 above and are summarized below.

System Capabilities Enhancement Area

- Global airspace system
- Consensus among users, and between users and service providers
- Human-centered approach system design
- Adequate backup and security procedures
- Information will be provided in a timely and consistent manner across the NAS for both user and service provider
- An integrated telecommunications infrastructure
- Enhanced Airborne and ground situation awareness
- Increased usage of decision support systems
- Improved methods for collecting and processing NAS infrastructure data
- A common GIS format is used
- Operating procedures for service providers and users will accommodate the transition to Free Flight
- Roles and responsibilities for separation assurance will shift from total ATSP responsibility to shared responsibility
- Accommodation of UAVs, ELVs, and RLVs

Flight Planning Enhancement Area

- Enhanced accommodation of User Preferred Routing
- Significant improvements in the planning data available to all users
- Enhanced flight plan will be available that provides a much larger data set
- GA user has the capability to access the same flight data used by all other system users
- Interactive Flight Planning Aids
- Today's flight plan will be replaced by a flight object
- For airborne flights, new profiles that do not require a tactical change to trajectory are processed automatically and included into the system

Separation Assurance Enhancement Area

In the future terminal area, the ATSP will:

- Clear properly equipped aircraft for free maneuvering when appropriate in low-density areas;

- Give authority to properly equipped aircraft to maneuver as necessary to avoid weather cells, or to follow such aircraft using self-spacing procedures;
- Clear properly equipped aircraft to self-separate and maintain sequence (i.e., station keeping) when appropriate; and
- Clear appropriately equipped aircraft to merge with another arrival stream, and/or maintain in-trail separation relative to a leading aircraft.

In the future terminal area, the pilot will:

- Conduct closely spaced independent approaches by utilizing surveillance data, on-board avionics and new air-ground procedures to ensure safe separation; and
- Use collision avoidance and escape guidance logic, real-time wake turbulence prediction, and flight deck situation awareness to perform free maneuvering when allowed.

In the future en route area, the ATSP will:

- Approve or deny proposed flight plan changes, except those needed for cockpit self-separation when that responsibility has been transferred to the flight deck.
- Provide a static route structure when necessary
- For places of continuous high density
- To provide for avoidance of terrain and active SUAs
- For transition between areas of differing separation standards.
- Clear properly equipped aircraft for free maneuvering when appropriate in low-density areas.
- Clear properly equipped aircraft for cockpit self-separation when operationally advantageous in high-density areas.

In the future en route area, the pilot will:

- Perform some spacing activities that were previously performed by the service provider. These activities will be performed for metering or merging purposes
- Monitor en route position using a GPS receiver or other area navigation capability with a moving map and enhanced ground proximity warning systems.

In the future en route area, the AOC will:

- Provide additional user intent and aircraft performance data to decision support systems, thus improving the accuracy of ground-based trajectory predictions and the performance of the separation assurance function.
- Approve or deny proposed flight plan changes, except those needed for cockpit self-separation when that responsibility has been transferred to the flight deck.
- Clear properly equipped aircraft for cockpit self-separation when operationally advantageous in high-density areas.
- Provide for special maneuvers that include:
    - Reduced-separation in-trail climb and descent
    - Lead climb and descent
    - Limited-duration station-keeping

  - Lateral passing.

In the future oceanic area, the pilot will:

- Perform some separation and merging activities that were previously performed by the service provider.

In the future oceanic area, the AOC will:

- Provide additional user intent and aircraft performance data to decision support systems, thus improving the accuracy of ground-based trajectory predictions and the reliability of conflict detection and resolution tools.

Situational Awareness and Advisory Enhancement Area

The future situational awareness and advisory services will be based upon the enhancement of the near-term system capabilities resulting from the “real time” sharing of information regarding the NAS, traffic, weather, and system demand.

This area will be enhanced through the use of improved weather radars, advanced conflict detection and prediction systems, data link, new avionics such as ADS-B and multi-function displays, and the implementation of decision support tools both on-board the aircraft and in the ATC automation system.

In the future surface operations, the ATSP will:

- Provide a surface management information system to enable data connectivity between the service provider, flight deck, airline operations center, ramp, airport operator, and airport emergency centers.
- Provide access to:
  - Arrival, departure, taxi schedules, and taxi routes
  - Airborne and surface surveillance information
  - Flight information and pilot reports
  - Weather information, including current weather maps.
- Provide ATIS and other weather information by data link.
- As necessary for user self-separation, mark locations of obstructions in and around some airports with ADS-B transmitters.

In the future surface operations the pilot will:

- Use automatic dependent surveillance, data link, and a multi-function display to enhance airport situational awareness of surface traffic, weather, and airport conditions.

In the future en route area, the ATSP will:

- Provide traffic advisories to uncontrolled aircraft.

In the future en route area, the AOC will:

- Monitor the status of the NAS and relay status information to pilots.

Navigation and Landing Enhancement Area

In the future terminal area, the ATSP will provide for multiple arrival and departure routes based on area navigation in high-density terminal-areas; provide, via data link, information regarding routes in use to pilots in properly equipped aircraft; and provide supporting augmentation at some airports to enable precision approaches using satellite-based navigation

In the future terminal area, the pilot will conduct approaches using all available navigation systems, and conduct closely spaced independent approaches by utilizing surveillance data, on-board avionics and new air-ground procedures to ensure safe separation.

The future en route roles and responsibilities for the pilot include, but are not limited to the capability to navigate and monitor position en route using a GPS receiver or other area navigation capability with a moving map enhances ground proximity warning systems.

In the future, oceanic separation minima will be significantly reduced, allowing a corresponding increase in traffic demand, due to the following improvements:

- International agreements and standards for satellite-based systems to ensure global interoperability will be established.
- Satellite navigation systems and data link will allow more accurate and frequent traffic position updates
- Aircraft position updates will be automatically supplied by the aircraft's broadcast of satellite navigation-derived position data.
- New advancements in ATC decision support tools, data link communications, surveillance, and navigation will facilitate merging domestic en route and oceanic control methods.
- Most aircraft will navigate using a global satellite navigation system whose improved accuracy will generate the required safety for reduced separation standards.
- Many aircraft will be Future Air Navigation System-1 (FANS-1) equipped or have the required navigation performance capability for reduced separation standards. DoD will use satellite based navigation systems to supplement today's inertial navigation systems.
- Satellite-based navigation will emerge as the sole means of navigation, with inertial systems used as a backup.

Traffic Management - Strategic Flow Enhancement Area

In the future, the ATSP will:

- Manage programs and flow initiatives to mitigate instances where demand exceeds capacity.
- Allocate airport capacity in the form of an arrival interval and the designated number of flights within that interval, when strategic flow management constraints are necessary.
- Provide a temporary route structure, with transition points for moving to and from user trajectories, when the projected demand for volumes of airspace is at or near capacity.
- Monitor user compliance with traffic flow management initiatives and apply punitive controls as necessary. Apply aggregate flow directives rather than flight-specific strategic control when possible.
- Monitor NAS performance and adjust traffic management strategies as needed. When possible, resolve traffic flow management problems at the local level.

In the future, the AOC will:

- Resolve traffic flow management issues collaboratively.

- Identify a temporary route structure when the projected demand for volumes of airspace is at or near capacity.

<u>Traffic Management - Synchronization Enhancement Area</u>

In the future surface domain, the ATSP will:

- Use a surface management information system that enables data connectivity between the service provider, flight deck, airline operations center, ramp, airport operator, and airport emergency centers. The system will provide access to:
    - ATIS and other airport environmental information, including RVR, braking action and surface condition reports, and current precipitation, runway availability, and wake turbulence and wind shear advisories
    - Arrival, departure, taxi schedules, and taxi routes
    - Airborne and surface surveillance information
    - Flight information and pilot reports
    - Weather information, including current weather maps
    - Clearance delivery and taxi instructions
    - Traffic management initiatives.
- When appropriate, clear properly equipped aircraft to self-separate and maintain sequence on the airport surface.
- As necessary, perform taxi sequencing based on user preferences, conformance monitoring, and conflict checking.
- At busy airports, perform surface movement planning. This planning includes:
    - Establishment of taxi-times based on weather and airport configurations
    - Establishment of aircraft movement times required to accomplish deicing with minimal delay from station to departure. Authorize properly equipped aircraft for lower RVR operations than those that are not equipped.
- Evaluate results and adjust automation system parameters as needed.

Future departure and arrival operations will be characterized by the following:

- Decision support systems that increase the efficient use of airport assets by providing assistance in arrival and departure sequences and spacing. This includes access to better information regarding the kind and amount of traffic coming into a terminal area. It also includes automated coordination between service providers within the terminal area and in neighboring facilities.
- Each flight's route, type, equipage, and destination define many procedurally required tasks, based on a Letter of Agreement and facility procedures.
- Arrival flows and departure queues will be planned around projected times for runway configuration changes that cause the least traffic disruption.

In the future terminal area the ATSP will:

- Assign arrival runways.

- When appropriate in low-density areas, clear properly equipped aircraft for free maneuvering. Properly equipped aircraft are given authority to maneuver as necessary to avoid weather cells, or to follow such aircraft using self-spacing procedures.
- In high-density areas, ATC will provide oversight for sequencing and primary separation assurance. When appropriate, clear properly equipped aircraft to self-separate and maintain sequence ("station-keeping."). Appropriately equipped aircraft will be given clearance to merge with another arrival stream, and/or maintain in-trail separation relative to a leading aircraft. Controllers may enable a function that automatically accepts handoffs on flights that are projected to be conflict-free across the sector. This function can be enabled/disabled at will. If this function is disabled, handoffs are processed manually. When enabled, the function accepts the handoff for each conflict-free flight at its penetration avoidance point.

In the future terminal area of traffic management-synchronization, the pilot will:

- Use collision avoidance and escape guidance logic, real-time wake turbulence prediction, and flight deck situation awareness to perform simultaneous approaches to closely spaced runways in IMC. Be able to select preferred routing. Routes in use will be sent via data link to pilots in properly equipped aircraft. This information will be exchanged with ATC and used in terminal-area decision support systems to provide appropriate sequencing.
- Fly to meet RTA, thereby improving the use of airport assets.

As a result, en route operations will be characterized by the following:

- The SWIMS is continually updated with changes in airspace and route structures, and with the positions and predicted time-based trajectories of the traffic. The systems and interfaces necessary to perform this continual updating are in place.
- The use of en route airborne holding will be reduced with the implementation of other procedures that improve traffic flow patterns and make maximum use of available terminal capacity.
- Additional intent and aircraft performance data will be provided to decision support systems, thus improving the accuracy of trajectory predictions. This information will be combined and presented on the service provider's display.
- There will be different separation standards depending on the flight's equipage and the quality of the positional data. Service provider displays will indicate the quality of the resulting aircraft positions and the appropriate equipage information.
- Reduced or time-based separation standards will be developed based on technology and aircraft capability, further increasing system capacity and safety.
- More accurate NAS information, together with improved automation (ground and air) will enable user-preferred routes that will be routinely flown with a minimum of rerouting.
- Facility boundaries will be adjusted to accommodate dynamic changes in traffic flow or weather. Route structure will be an exception, not a rule.
- Static route structures will still exist only when necessary (e.g., places of continuous high density, to provide for avoidance of terrain and active SUAs, and for transition between areas with differing separation standards).

In the future the en route ATSP will:

- When appropriate, use a “metering spacing technique” to provide the user the flexibility to efficiently manage a flight.
- Provide only one clearance for metering spacing to properly equipped aircraft.
- When appropriate in low-density areas, clear properly equipped aircraft for free maneuvering.
- Maintain oversight in high-density areas for sequencing and primary separation assurance.
- Provide automated hand-off between US and Mexican ATC systems, and between US and Canadian ATC systems.
- Consider AOC and flight deck preferences while assigning routes and controlling aircraft, modified routes can be developed collaboratively between the AOC and the service provider and then data linked to the cockpit and downstream ATC facilities.

In the future en route area of traffic management-synchronization, the Pilot will:

- Perform some spacing activities that were previously performed by the service provider. These activities will be performed for metering or merging purposes.

In the future en route area of traffic management-synchronization, the AOC will:

- Provide additional user intent and aircraft performance data to decision support systems, thus improving the accuracy of ground-based trajectory predictions.

Oceanic separation minima will be significantly reduced, allowing a corresponding increase in traffic demand, due to the following improvements:

- Rapid delivery of clearances by the service providers, and responses by the flight deck, are achieved through increasingly common use of data link.
- Procedural reductions in separation standards will be facilitated through the improved infrastructure

In the future the oceanic ATSP will:

- Provide for special maneuvers that include:
    - Reduced-separation in-trail climb and descent
    - Lead climb and descent
    - Limited-duration station-keeping
    - Lateral passing.
- Provide a capability for secure-encryption data link of weather and air traffic management information to accommodate DoD user needs.

In the future oceanic area, the Pilot will:

- Perform some separation and merging activities that were previously performed by the service provider.

In the future oceanic area, the AOC will:

- Provide additional user intent and aircraft performance data to decision support systems, thus improving the accuracy of ground-based trajectory predictions.

Airspace Management Enhancement Area

- Airspace management enhancements will be required to accommodate new classes of vehicles: the Tilt Rotor, UAV, RLV, and ELV.
- Airspace design will allow for multiple arrival and departure routes based on area navigation
- Separation standards may vary depending on equipage and the quality of positional data for individual flights
- En route flights will routinely operate on user-preferred en route trajectories
- Facility boundaries will be adjusted to accommodate dynamic changes in traffic
- High altitude airspace structure has laterally defined sectors that encompass much larger areas
- The oceanic environment closely resembles the domestic en route environment

Emergency and Alerting Enhancement Area

- Improved ELTs use discreet codes and satellite based navigation positioning information
- Improved flight following services for VFR traffic

Infrastructure/Information Management Enhancement Area

- Infrastructure O&M will be performed from the viewpoint of customer requirements
- Increased equipment and system self-monitoring and self-restoration
- Surveillance will be accomplished through a combination of primary radar, beacon interrogation, and broadcasts of aircraft position and speed
- Increased use of data link
- New advancements in ATC DSTs, data link communications, surveillance, and navigation will facilitate merging domestic en route and oceanic control methods.
- Full-time monitoring and control of NAS infrastructure service delivery and systems
- Event Management will be used to classify and type events, and track NAS maintenance activities
- NAS infrastructure assets are assigned/reassigned dynamically to mitigate infrastructure problems
- A management information system will provide automated access to management data about NAS operations and infrastructure
- The SWIMS will makes information available to all service providers for a common understanding of situations
- A common understanding of significant weather will be shared by user and provider,
- A system wide concept of operations for information security
- Space vehicles operate from dual use facilities that accommodate both aviation and launch/reentry operations

7.2 Organizational Impacts

To be determined

7.3 Impacts during Development

The NAS of the long term future is at a very early stage of development. As such, it is difficult to determine the impacts on the user, acquirer, and maintenance organizations during development. It is however required that FAA air traffic controllers participate in the development process during demonstration and test phases. Significant impacts are however expected on the user, developer, and on the ATM system personnel during development because of the significant paradigm shifts that are expected to result from this effort.

8. Analysis of the Proposed System

8.1 Summary of Advantages

The benefits associated with the enhancements to the NAS described in this OCD are presented below and are categorized according to the specific enhancement are that accrues the benefit.

System Capabilities Enhancement Area Benefits: Practically all of the System Capabilities Enhancements as described in this area are enablers of other capabilities that are described in other Enhancement Areas. As such, it is difficult to assign benefits to achieving these capabilities. Those assignments are best done when considering individual Enhancement Areas or applications. If a System Capabilities statement spans multiple enhancement areas, then some method must be developed to allocate the benefits to individual applications or Enhancement Areas.

Flight Planning Enhancement Area Benefits

The following benefits are attributed to the flight planning enhancements described in the above sections:

- Increased flexibility and user efficiency (e.g., adherence to schedule, reduced fuel, reduced flight time), due to user-preferred pre-flight and in-flight planning.
- Reduction in excessive and non-preferred deviations for local TFM conformance, due to the ability of the flight crew (of appropriately equipped aircraft) to maintain local TFM conformance according to their preferences through improved in-flight planning.
- Reduced ATSP workload for local TFM conformance through in-flight planning, plus reduced flight crew workload for communications, due to distribution of responsibility for local TFM conformance between the ATSP and appropriately equipped FDs.
- Interactive flight planning allows users to better monitor fleet activities during routine and non-routine operations, which results in better resource utilization and cost savings.
- Inclusion of the airspace users' input to solutions that affect the whole population of aircraft and their flight plans and thus affect the airlines' bottom line (i.e., profit).
- A common information baseline will be used for traffic planning which will permit the user to provide effective and efficient flight plans.

Separation Assurance Enhancement Benefits

The following benefits beyond current capabilities are attributed to the separation assurance enhancements described in the above sections:

- Reduction in excessive and non-preferred deviations for separation assurance, due to:
    - The ability of the flight crew (of appropriately equipped aircraft) to self-separate according to their preferences.
    - User-ATSP collaboration for conflict resolution maneuvers.
- Improved CD&R capabilities of ATSP-based DSTs, enabled by user-supplied data on key flight parameters.
- Increased safety in separation assurance for all aircraft, due to CNS redundancy (FD as primary and ATC as backup) and increased situational awareness on the FD of appropriately equipped aircraft.

- Reduced ATSP workload for separation assurance, plus reduced flight crew workload for communications, due to distribution of responsibility for separation assurance between the ATSP and appropriately equipped FDs.
- Increased user flexibility/efficiency in avoiding weather cells, due to:
  - FD autonomy
  - Accommodation of user preferences in ATSP planning for trajectory deviations.
- Reduced ATSP workload, due to:
  - Delegation of weather avoidance and traffic separation responsibility to the flight crew and reduced voice communications resulting from elimination of vectoring instructions for free maneuvering aircraft.
  - Improved CD&R capabilities (enabled by user-supplied data) for separation assurance, and intelligent user requests for trajectory changes that conform to local traffic and TFM constraints.
- Increased terminal area throughput, due to more efficient arrival trajectories for appropriately equipped aircraft.
- Increased arrival capacity/throughput rate during IMC, due to execution of closely spaced approaches.
- The introduction of ADS-B combined with CDTI increases the level of pilot situation awareness in properly equipped aircraft.
- CDTI, used in conjunction with satellite-based navigation systems, allows reduced separation standards in oceanic airspace.
- The potential for CFIT has been significantly reduced for aircraft equipped with an EGPWS (based on GPS-derived position compared with a stored terrain database) which allows the pilot to more readily monitor terrain clearance.
- Decision support systems will increase the efficient use of airport assets by providing assistance in planning taxi sequences and spacing, in the assignment of aircraft to runways, and in arrival and departure sequences and spacing.
- Improved decision support tools for conflict detection, resolution, and flow management allow increased accommodation of user-preferred trajectories, schedules, and flight sequences. Airborne procedures enhance the availability of user-preferred routes, particularly for properly equipped aircraft at low altitudes.
- The use of satellite-based navigation and surveillance data will not only increase on-board capabilities ranging from cockpit traffic and enhanced collision avoidance logic, but will also be used by ground-system automation for enhanced conflict probe and alerting.

Situational Awareness and Advisory Enhancement Benefits

The following benefits are attributed to the situational awareness and advisory enhancements described in the above sections:

- All parties involved in collaboration share a common situation awareness, using the best, most timely information possible.
- Airborne and ground situation awareness is enhanced by the availability of Automatic Dependent Surveillance (ADS). ADS-B enables positive control in non-radar environments.

- Enhanced visual acquisition of other traffic in the VFR traffic pattern at uncontrolled (non-tower) airports using ADS-B.
- Retransmit position reports from all pertinent aircraft from the traffic information service back to the cockpit.
- Enhanced CDTI may enable the transfer of responsibility for separation assurance to the flight deck for some operations.
- Accurate weather information is available to the service provider and user, including automatic simultaneous broadcast of hazardous weather alerts for wind shear, microbursts, gust fronts, and areas of precipitation, icing, and low visibility.

Navigation and Landing Enhancement Area Benefits: Navigation and Landing enhancements are enablers of other capabilities that are described in other Enhancement Areas. As such, it is difficult to assign benefits to achieving these capabilities. Those assignments are best done when considering individual Enhancement Areas or applications. If a Navigation and Landing improvement supports multiple other enhancement areas, then some method must be developed to allocate the benefits to individual applications or Enhancement Areas.

Traffic Management - Strategic Flow Enhancement Benefits: The flying public and private sectors will directly benefit from reduced transportation costs and increased schedule/connectivity. The general public will indirectly benefit from the resulting economic growth (national productivity and gross national product) enabled by a more productive and efficient transportation system. Another benefit is the distribution of the cost for NAS modernization. The users to a greater extent shall share the cost. This is likely to lead to acceleration in the realization of benefits to all NAS stakeholders.

User efficiency will be increased through increased accommodation of user-preferred deviations in constrained en route airspace, due to user options for pre-emptive action and the incorporation of user input/preferences into ATSP's management of traffic flow. Increased user efficiency, ATSP productivity and system capacity, also result due to the adoption of a strategic and collaborative approach to the management of constrained en route airspace.

Traffic Management - Synchronization Enhancement Benefits: The primary economical user-benefit of Free Flight is that it gives users maximum opportunity to self-optimize their operations within the dynamic constraints of the ATM system. The most obvious user benefit is a reduction in the per-flight direct operating cost that every user operating under IFR can obtain through real-time optimization of their flight trajectory.

Benefits are achieved by:

- Reduced departure delay and taxi time, and due to efficient pushback time.
- Reduced fuel consumption and emissions, due to decreased engine operation time on the ground (resulting from efficient pushback time).
- Increased taxi efficiency, due to data link capabilities which may decrease or eliminate the need to stop while receiving a taxi clearance.
- Reduced workload, due to decreased verbal communication, frequency congestion, and opportunities for communication errors.
- Increased departure efficiency, due to user's ability to select or influence their own departure trajectories.

- Reduced controller workload due to reduced voice communications, particularly in regions of high frequency congestion.
- Increased ATSP accommodation of user requests for trajectory changes, due to the user's ability to intelligently formulate trajectory change requests that conform to local traffic and TFM constraints.
- Reduced ATSP workload, due to intelligent user requests for trajectory changes that conform to local traffic and TFM constraints.
- Increased accommodation of user-preferred deviations in constrained en route airspace, due to user options for pre-emptive action and the incorporation of user input/preferences into ATSP's management of traffic flow.
- Increased user efficiency, ATSP productivity and system capacity, due to the adoption of a strategic and collaborative approach to the management of constrained en route airspace.
- Increased user flexibility and efficiency for arrivals in congested terminal airspace, due to strategic collaboration between user and ATSP for determining arrival times, runways and meter-fixes.
- Reduced arrival delays, due to efficient arrival metering resulting from improved ATSP predictions of arrival traffic load.
- Increased airline hub operating efficiencies, due AOC's ability to influence sequencing of flights in their arrival bank.
- Increased arrival capacity/throughput in IMC, due to:
    - A reduction in excessive spacing buffers resulting from the ability of appropriately equipped aircraft to operate as if they were in VMC.
    - A reduction in excessive spacing buffers resulting from the exchange of trajectory information between user and ATSP.
- reduced delays in gate arrival, due to decreased active runway crossing hold delays.

Airspace Management Enhancement Benefits: The benefits of Airspace Management Enhancements include airspace capacity increases, enhanced user flexibility and efficiency, and reduced delays. These benefits accrue primarily through:

- Increased ATSP productivity through improved DSTs and seamless inter and intra facility communication and coordination which provides greater flexibility to respond to user requests.
- Reduced separation standards increases airway capacity.
- More flexible routes that more closely meet user requests.
- Dynamic airspace structures make more efficient use of airspace and decrease bottlenecks and reduce delays.
- Ability to effectively use unique characteristics of Tilt Rotor aircraft.
- Ability to integrate UAV/RLV/ELV into NAS operations with minimum disruption.

Emergency and Alerting Enhancement Benefits: Search and Rescue capabilities are enhanced by improved ELTs which improve the survival probability for downed aircraft. Improved flight following services for VFR traffic assist in reducing the number of lost aircraft and increase safety of flight.

Infrastructure/Information Management Enhancement Benefits: Along with modernization benefits, there will be economical benefits. The flying public and private sectors will directly benefit from reduced transportation costs and increased schedule/connectivity. The general public will indirectly benefit from the resulting economic growth (national productivity and gross national product) enabled by a more productive and efficient transportation system. Another benefit is the distribution of the cost for NAS modernization. The users to a greater extent shall share the cost. This is likely to lead to acceleration in the realization of benefits to all NAS stakeholders.

8.2 Summary of Disadvantages/Limitations

If the future NAS operational concept fulfills its objectives, there are few, if any disadvantages or limitations that can be identified at this stage of development. This does not mean that it has been proven that the benefits achievable with the future NAS exceed the implementation costs (e.g., research, development, equipage). Further, it is expected that disadvantages and/or limitations will become apparent as the research is conducted.

8.3 Alternatives and Tradeoffs Considered

The NAS operational concept of the future is at a very early stage of development. As such, several alternatives and tradeoffs yet to be identified will be investigated as part of the concept research effort.

9. Notes

Abbreviations and Acronyms

2D	Two Dimensional
3D	Three Dimensional
4D	Four Dimensional
AATM	Assistant Air Traffic Manager
AATT	Advanced Air Transportation Technologies
ACARS	ARINC Communications Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
ADF	Automatic Direction Finder
ADS	Automatic Dependent Surveillance
ADS-A/C	Automatic Dependent Surveillance – Addressable/Command Mode
ADS-B	Automatic Dependent Surveillance - Broadcast
aFAST	Active Final Approach Spacing Tool
AIRMET	Airman’s Meteorological Information
ALTRV	Altitude Reservation
AM	Area Manager
AMA	Assistant Manager for Automation
AMIC	Area Manager in Charge
AOC	Airline Operations Center
AOM	
AOP	Autonomous Operations Planner
ARINC	Aeronautical Radio Incorporated
ARSA	
ARSR	Air Route Surveillance Radar
ARTS	Automated Radar Terminal System
ARTCC	Air Route Traffic Control Center
AS	Area Supervisor
ASD	Airborne Situation Display
ASDE	Airport Surface Detection Equipment
ASP	Arrival Spacing Program
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATCS	Air Traffic Control Specialist
ATCSCC	Air Traffic Control System Command Center
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATMCP	Air Traffic Management Operations Concept Panel
ATS	Air Traffic Service
ATSP	Air Traffic Service Provider
AUTOVON	Automated Voice Network
AUS	Automation Specialist
AVARS	Automated Voice Airport Reservation System
AWIS	Automated Weather Information System
AWP	Aviation Weather Processor
BRITE	Bright Radar Indicator Tower Equipment
CAASD	Center for Advanced Aviation System Development
CAP	Collaborative Arrival Planner
CARF	Central Altitude Reservation Function
CAT-I	Category One
CAT-II	Category Two

CAT-III	Category Three
CC	Cab Coordinator
CCLD	Core Capability Limited Deployment
CCPs	Capacity Control Programs
CD	Clearance Delivery
CD&R	Conflict Detection and Resolution
CDC	Common Display Channel
CDM	Collaborative Decision Making
CDR	Critical Data Recording
CDTI	Cockpit Display of Traffic Information
CE	Concept Element
CENRAP	Central ARTS Radar Processing
CFIT	Controlled Flight into Terrain
CHI	Computer Human Interface
CIC	Capacity Increasing Concepts
CNS	Communication, Navigation, and Surveillance
CPDLC	Controller Pilot Data Link Communication
CRCT	Collaboration Routing Coordination Tool
CRD	Computer Readout Device
CRS	Common Reference System
CRT	Cathode Ray Tube
CTA	Controlled Time of Arrival
CTAS	Center TRACON Automation System
CWSU	Center Weather Service Unit
D2	Direct To
DAG	Distributed Air/Ground
DAG CE	Distributed Air/Ground Concept Element
DARC	Direct Access Radar Channel
DART	Data Analysis and Reduction Tool
DASI	Digital Altimeter Setting Indicator
DCB	
DF	Direction Finder
DME	Distance Measuring Equipment
DMS	Demand Module Schedule
DMT	Demand Module Time
DoD	Department of Defense
DOT	Department of Transportation
DOTS	Dynamic Ocean Tracking System
DSS	Data System Specialist
DSTs	Decision Support Tools
DUATS	Direct User Access Terminal Service
EDA	En Route and Descent Advisor
EDP	Expedite Departure Path
EDX	En Route Data Exchange
EFAS	En Route Flight Advisory System
EGPWS	Enhanced Ground Proximity Warning System
ELT	Emergency Locator Transmitter
ELV	Expendable Launch Vehicle
ETA	Estimated Time of Arrival
FAA	Federal Aviation Administration
FAATC	FAA Technical Center

FACET	Future ATM Concepts Enhancement Tool
FANS	Future Air Navigation System
FASA	Final Approach Spacing Aid
FAST	Final Approach Spacing Tool
FBO	Fixed Base Operator
FD	Flight Deck
	Flight Data
FDIO	Flight Data Input Output
FFP I	Free Flight Phase One
FFPII	Free Flight Phase Two
FFT	Free Flow Time
FIR	Flight Information Region
FIS	Flight Information Service
FIS-B	Flight Information Service – Broadcast
FL	Flight Level
FMS	Flight Management System
FPL	Filed Flight Plan
FSAS	Flight Services Automation System
FSDPS	Flight Services Data Processing System
FSS	Flight Service Station
FW	Flight Watch
GA	General Aviation
GATM	Global Air Traffic Management
GC	Ground Control
GDP	Ground Delay Program
GDPE	Ground Delay Program Enhanced
GH	Gate Hold
GIS	Geographic Information System
GOES	Geostationary Orbiting Environmental Satellite
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HARS	High Altitude Route System
HCS	Host Computer System
HF	High Frequency
HIWAS	Hazardous In-flight Weather Advisory System
ICAO	International Civil Aviation Organization
ICSS	Integrated Communication Switching System
IDS	Information Display System
IF	In Flight
IFCN	Interfacility Flow Control Network
IFR	Instrument Flight Rules
IGS	Intelligent Ground System
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
INS	Inertial Navigation System
ISM	Initial Surface Movement
LAAS	Local Area Augmentation System
LABS	Leased Service A and B
LC	Local Control
LLWAS	Low Level Windshear Alerting System
MARSA	Military Accepts Responsibility for Separation Assurance

McTMA	Multi-Center Traffic Management Advisor
METAR	Meteorological Aviation Report
M1FC	Model 1 N1 Capacity
MLS	Microwave Landing System
MMR	Multi-Mode Receivers
Mode S	Mode S Radar
MOS	Military Occupational Specialty
MSAW	Minimum Safe Altitude Warning
MSL	Mean Sea Level
MVMC	Marginal Visual Meteorological Conditions
MWP	Meteorological Weather Processor
NADIN	National Data Interchange Network
NAS	National Airspace System
NAS-WIS	National Airspace System-Wide Information System
NASA	National Aeronautics and Space Administration
NAVAID	Navigational Aid
NCP	NAS Change Proposal
NEXRAD	Next Generation Weather Radar
NFDC	National Flight Data Center
NOTAM	Notice to Airmen
NTAP	National Track Analysis Program
NTMO	National Traffic Management Officer
NWS	National Weather Service
OAG	Official Airline Guide
OALT	Operational Acceptable Level of Traffic
O&M	Operations and Maintenance
OCD	Operational Concept Description
ODAPS	Oceanic Data Processing System
OEDP	Operational Error Detection Program
OEP	Operational Evolution Plan
ONS	Operational Needs Statement
PATWAS	Pilot Automatic Telephone Weather Answering Service
PDA	Personal Digital Assistant
PDC	Pre-Departure Clearance
PF	Pre Flight
pFAST	Passive Final Approach Spacing Tool
PIREP	Pilot Report
PVD	Plan View Display
R	Radar
RA	Radar Associate
R&D	Research and Development
RASP	
RC	Radar Controller
RLV	Reusable Launch Vehicle
RMM	Remote Maintenance Monitoring
RNAV	Area Navigation
RRWDS	Remote Radar Weather Display System
R/T	Radio Telephony
RTA	Required Time of Arrival
RVR	Runway Visual Range
RVSM	Reduced Vertical Separation Minima

SAMS	Special Use Airspace Management System
SAR	Search and Rescue
SATNAV	Satellite Navigation
SE	System Engineer
SF	Strategic Flow
SF-21	Safe Flight 21
SFO	San Francisco Airport
SID	Standard Instrument Departure
SIGMET	Significant Meteorological Conditions
SMA	Surface Movement Advisor
SMS	Surface Management System
SSF	System Support Facility
SSR	Secondary Surveillance Radar
STA	Scheduled Time of Arrival
STARS	Standard Terminal Automation Replacement System
STAR	Standard Terminal Arrival Route
S/TFM	Strategic Traffic Flow Management
SUA	Special Use Airspace
SVFR	Special VFR
SWB	Scheduled Weather Broadcast
SWIMS	System Wide Information Management System
TAF	Terminal Area Forecast
TCA	Terminal Control Area
TCAS	Traffic Alert and Collision Avoidance System
TDWR	Terminal Doppler Weather Radar
TECS	Tower En Route Control Service
TERPs	Terminal Radar Procedures
TIBS	Telephone Information Briefing Service
TIS	Traffic Information Service
TIS-B	Traffic Information Service – Broadcast
TFM	Traffic Flow Management
TM	Traffic Management
TMA	Traffic Management Advisor
TMA-MC	Traffic Management Advisor – Multi Center
TMA-SC	Traffic Management Advisor – Single Center
TMC	Traffic Management Coordinator
TMS	Traffic Management System
TMU	Traffic Management Unit
TRACON	Terminal Radar Approach Control
TS	
TTMU	Terminal TMU
TWEB	Transcribed Weather En Route Broadcast
URET	User Request Evaluation Tool
UAV	Unmanned Air Vehicle
USNS	U.S. NOTAM Service
US	United States
VAMS	Virtual Airspace Modeling System
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Range
WAAS	Wide Area Augmentation System

WGS	World Geodetic System
WMSC	Weather Message Switching Center

10. Annexes

ATC Controller Position Descriptions

TERMINAL FACILITIES

TOWER

Area Supervisor (AS)

The tower cab AS is responsible for overall tower cab operation. This includes management and direction of tower cab personnel, and observing, scanning and projecting the needs of the constantly changing airport operation.

INPUTS:

- Visual observation of tower cab operations
- Flight progress strips
- Status information area
- Coordination from tower cab positions
- Systems displays (see below)
- TRACON Area Supervisor (AS)
- Area Manager (AM)

PROCESS:

- Analyze information to determine priority of duties
- Project and plan traffic flows, traffic management, facility procedures, field/weather conditions, staffing and position configurations
- Analyze/evaluate effectiveness of plan

OUTPUTS:

- Ensure dissemination to pilots information concerning vehicle conditions that may affect operations
- Coordinate with tower cab positions, TTMU, TRACON AS and AM
- Ensure tower cab operations are in accordance with procedures, current flows and weather conditions
- Ensure adequate staffing
- Combine/decombine tower cab positions
- Initiate action as input changes

SYSTEMS:

- ICSS, BRITE, RVR, ARTS, Information Display System (IDS), NAVAIDS panel, field lighting panel, coordination lights, LLWAS, 24-hour ZULU (Z-time, or Greenwich Mean Time) clock, ASDE, AWDS, crash phone system

Cab Coordinator (CC)

The CC is primarily responsible for observing and scanning the active runways and airport traffic area/control zone to assist the LC. CC will coordinate for the LC and ensure procedures and flows are adhered to in the rapidly changing airport environment.

INPUTS:

- Receive requests for air traffic movement
- Visual observation of runways, taxiways, traffic pattern and airport traffic area/control zone
- Flight progress strips
- Status information area
- Coordination from other tower cab and TRACON positions
- Terminal Traffic Management Unit (TTMU)
- Area Supervisor (AS)

PROCESS:

- Observe local control (LC) operations and coordinate for the LC
- Analyze information to determine priority of duties
- Project and plan traffic flows, traffic management, separation standards, pilot requests, facility procedures, field/weather conditions and aircraft performance.
- Review flight progress strips
- Ensure dissemination of information to pilots, vehicle operators, other cab positions, and the supervisor, of conditions that may affect operations
- Analyze/evaluate effectiveness of plan

OUTPUTS:

- Coordinate for the LC with other tower cab and TRACON positions
- Scan airport operations and assist LC with duties
- Report airport conditions
- Forward flight progress strips
- Initiate action as input changes

SYSTEMS:

- ICSS, BRITE, light guns, RVR, ARTS, IDS, NAVAIDS panel, field lighting panel, coordination lights, LLWAS, 24-hour Z-time clock, ASDE, AWDS, crash phone system

Local Control (LC)

The LC is primarily responsible for handling arriving and departing traffic at the airport. The area of responsibility includes the active runways and airport traffic area/control zone. It is a rapidly changing environment requiring constant evaluation of input and modification to existing plans. The LC position interfaces mainly with Ground Control (GC) and TRACON positions.

INPUTS:

- Receive request for air traffic movement
- Visual Observation of Runways, taxiways, traffic pattern and airport traffic area/control zone
- Radios
- Flight progress strips
- Status information area
- Coordination from other tower cab and TRACON positions
- Terminal Traffic Management Unit (TTMU)
- Tower cab Area Supervisor (AS)

PROCESS:

- Analyze information to determine priority of duties
- Project and plan ATC service based upon traffic flows, traffic management, separation standards, pilot requests, facility procedures, field and weather conditions, and aircraft performance
- Obtain, review, amend and mark flight progress strips
- Ensure dissemination of information to pilots, vehicle operators, other tower cab positions and AS of conditions that may affect operations.
- Analyze/evaluate effectiveness of plan

OUTPUTS:

- Issue arrival, departure, airport traffic area/control zone transition instructions
- Issue traffic information
- Report airport conditions
- Coordinate with other tower cab and TRACON positions
- Forward flight progress strips
- Disseminate to pilots, vehicle operators, other tower cab positions and AS information that may affect airport operations
- Record arrival/departure transition information
- Initiate action as input changes

SYSTEMS:

- ICSS, radios, BRITE, light guns, RVR, ARTS, IDS, NAVAIDS panel, field lighting panel, coordination lights, LLWAS, 24-hour Z-time dock, ASDE, AWDS, crash phone system, DASI, Wind instruments

Ground Control (GC)

The GC is primarily responsible for directing aircraft to and from the runway. Additional duties include directing other aircraft/vehicular movement on the airport movement area and disseminating information to support operations (e.g., traffic, weather, equipment status, delays/flow etc,). It is a dynamic environment in which the GC must adjust traffic flows and evaluate new information.

INPUTS:

- Receive request for ground movement
- Visual observation of movement area
- Radios
- Flight progress strip
- Status information area
- Coordination from other tower cab positions
- Terminal Traffic Management Unit (TTMU)
- Tower cab Area Supervisor (AS)

PROCESS:

- Analyze information to determine priority of duties
- Project and plan traffic flows, traffic management, pilot requests, facility procedures, field/weather conditions and aircraft performance
- Obtain, review, amend and mark flight progress strips
- Ensure dissemination of information to pilots, vehicle operators, other tower cab positions and the AS of conditions that may affect operations
- Analyze/evaluate effectiveness of plan

OUTPUTS:

- Issue ground movement instructions
- Issue traffic information
- Report airport conditions
- Coordinate with other tower cab positions
- Forward flight progress strips
- Issue/ensure pilot has received current airport, weather and departure information
- Record ground movement and other significant information
- Initiate action as input changes

SYSTEMS:

- ICSS, radios, BRITE, light guns, RVR, ARTS, IDS, NAVAIDS panel, field lighting panel, coordination lights, LLWAS, 24-hour Z-time clock, ASDE, AWDS, crash phone system

Gate Hold (GH)

The GH position is intended to inform pilots when departure delays exceed or are anticipated to exceed 15 minutes. GH delivers aircraft to the ground controller in an orderly flow to minimize congestion on the movement area. Pilots monitor the frequency for engine start-up advisories or new proposed start times if the delay changes.

INPUTS:

- Requests for engine start time
- Visual observation of movement area
- Radios
- Flight progress strips
- Status information area
- Terminal Traffic Management Unit (TTMU)
- Tower cab Area Supervisor (AS)

PROCESS:

- Analyze gate hold (GH) and traffic management requirements and implement gate hold procedures
- Record time of initial call-up on flight progress strips
- Maintain sequence for departure using initial call-up time, unless modified by flow control restrictions

OUTPUTS:

- Issue pilot engine start times and subsequent revisions if delays change

SYSTEMS:

- ICSS, radios, 24-hour Z-time clock, ASDE, IDS

TOWER/TRACON

Clearance Delivery (CD)

The CD position primarily issues departure clearances to pilots. The clearance is delivered to the pilot on the radio or via ARINC Communications Addressing and Reporting System (ACARS). Additionally, weather, route, delay and other significant information may be relayed to pilots.

INPUTS:

- Requests for departure clearance
- Radios
- Flight progress strips
- Status information area
- Coordination from other tower/TRACON cab positions
- ARINC Communications Addressing and Reporting System (ACARS)
- Terminal Traffic Management Unit (TTMU)
- Area Supervisor (AS)

PROCESS:

- Upon receipt of flight plan/VFR departure information, ensure all required clearance items are received and recorded
- Forward clearance information to Flight Data (FD) for processing
- Obtain clearance from FD or formulate a clearance (e.g., IFR, TCA, ARSA, Stage III, SVFR, VFR-on-top, or other VFR departure)
- Apply strip marking procedures
- Place strips in designated area
- Periodically review strips for currency

OUTPUTS:

- Issue clearance to pilots and deliver information to Ground Control (GC) or Gate Hold (GH), if applicable.
- Coordinate information with other tower cab positions.

SYSTEMS:

- ICSS, radios, ARTS, IDS, ACARS, AWDS, 24-hour Z-time clock

Flight Data (FD)

The FD position primarily relays flight plan and airport information to other tower cab positions. FD closely interfaces with CD as a coordinator.

INPUTS:

- Receive weather information
- Flight progress strips
- Status information area
- Flight Data Input/Output (FDIO)
- Automated Weather Information System (AWIS)
- Automated Weather Display System (AWDS)
- National Weather Service (NWS)
- Notices to Airmen (NOTAMs)
- Coordination with other tower/TRACON positions, FSS, and ARTCC
- Terminal Traffic Management Unit (TTMU)
- Area Supervisor (AS)

PROCESS:

- Analyze information to determine priority of duties
- Review, amend aid mark flight progress strips
- Ensure dissemination of information that may affect operations to other positions
- Monitor and operate NAVAID panel, Automated Terminal Information System (ATIS), and FDIO

OUTPUT:

- Disseminate flight plan information, flight progress strip amendments, weather and traffic management information, and airport conditions
- Update status information area
- Record ATIS

SYSTEMS:

- ICSS, FDIO, AWIS, ATIS, ARTS, IDS, AWDS, 24-hour Z-time clock

Area Manager (AM)

The Area Manager has the responsibility for the entire facility's shift operation. By projecting, planning, coordinating and strategizing with shift supervisors, the Area Manager facilitates the use of available resources to meet the demands of air traffic.

INPUTS:

- TRACON Area Supervisor
- Tower Area Supervisor
- Automation Specialist
- Terminal Traffic Management Unit (TTMU)
- En route Area Manager
- Airport operators
- Facility Staff officers
- Airway Facility technicians
- National Weather Service
- Flight Service Stations

PROCESS:

- Administrate shift operations
- Project and plan shift staffing, runway openings and closures, equipment outages

OUTPUTS:

- Ensure information dissemination to TRACON/Tower Area Supervisors
- Ensure adequate supervisory staffing
- Coordinate with en route AM and TMS on airport conditions with NAS impact.
- Record facility operations
- Document equipment. outages/restorations

SYSTEMS:

- ARTS, ICSS, LLWAS, IDS, ASD, RVR, Digital Altimeter Setting Indicator, DASD, ASR, ILS, FDIO, Center ARTS Radar Processing (CENRAP).

Area Supervisor (AS)

The TRACON AS is responsible for overall TRACON operations. Through planning, monitoring and evaluating operations, the AS will use available resources to accommodate traffic demands. It is a constantly changing environment where anticipating and communicating needs are as important as current operations.

INPUTS:

- TRACON operations
- Flight progress strips
- Status information area
- Coordination from the TRACON positions
- Terminal Traffic Management Unit (TTMU)
- Tower cab Area Supervisor (AS)
- Area Manager (AM)

PROCESS:

- Analyze information to determine priority of duties
- Project and plan traffic flows, traffic management, facility procedures, field/weather conditions, staffing, and position configurations
- Analyze/evaluate effectiveness of plan

OUTPUTS:

- Ensure dissemination of information concerning conditions that may affect operations to TRACON positions, TTMU, tower cab AS and AM
- Coordinate with TRACON positions, tower cab AS, TTMU and AM
- Ensure TRACON operations are in accordance with procedures, current flows and weather conditions
- Ensure adequate staffing
- Combine/decombine TRACON positions
- Initiate action as input changes

SYSTEMS:

- ICSS, ARTS, LLWAS, 24-hour Z-time clock, AWDS, crash phone system, IDS, Aircraft Situational Display (ASD), Meteorologist Weather Processor (MWP) or Remote Radar Weather Display System (RRWDS)

Radar Position (R)

The Radar Control position is designed according to the desired function--arrival, departure, and satellite. The controller responsible for each sector has defined airspace and can use a variety of techniques to accomplish the assigned tasks (e.g., vectoring, speed control. sequencing, altitude, lateral, diverging, and visual separation). The level of service and separation applied to the individual aircraft is dependent upon numerous factors including the pilot's request, type of flight plan, type of aircraft, and weather.

Aircraft are generally routed via published or facility-established routes. When established routes are unavailable or unusable, aircraft are directed into current traffic flows to avoid conflicts, adverse weather, obstructions and terrain. Occasionally due to unusual circumstances aircraft may be issued holding instructions. The TRACON environment is rapidly changing as input changes (e.g., aircraft, weather, pilot requests, flow control). The Radar Controller must continually evaluate current operations, conditions, and the effectiveness of the action plan. As new input is received, the controller must be flexible, and rapidly incorporate the information into the action plan.

The arrival position(s) primarily sequences aircraft delivered from adjacent sectors or VFR "pop-up" aircraft to the destination airport. Service may be provided to more than one runway at one or more airports.

The departure position(s) primarily delivers departing aircraft from one or more airports to adjacent ATC facilities or out of controlled airspace, in accordance with established procedures.

The satellite position(s) normally provides arrival and departure service for secondary or military airports. Generally these aircraft are incorporated into the primary airport flow of traffic.

INPUTS:

- Pilot requests
- Pilot reports (PIREPS)
- Radar display
- Manual and automated handoffs
- Radios
- Flight progress strips
- Status information area
- Coordination from tower cab, other TRACON positions and adjacent ATC facilities
- Terminal Traffic Management Unit (TTMU)
- Area Supervisor (AS)

PROCESS:

- Prepare and monitor Radar position equipment for settings and optimum performance
- Correlate flight progress strips and Radar display information
- Manage flight progress strips: scan, analyze, transfer and file
- Mark flight progress strips as necessary
- Recognize, project and plan for sector workload

- Analyze traffic (e.g., volume, aircraft types and performance characteristics, requests) and evaluate additional factors (e.g., weather, equipment status, flow control) and develop an action plan
- Continuously evaluate the effectiveness of the plan and adjust as necessary

OUTPUTS:

- Issue control instructions, safety alerts, advisories and information
- Initiate control instructions and ensure separation
- Initiate manual and automated handoffs
- Disseminate weather information
- Make entries into ARTS computer system
- Coordinate with tower cab, other TRACON positions and adjacent ATC facilities

SYSTEMS:

- ICSS, RVR, ARTS, LLWAS, 24-hour Z-time clock, AWDS, IDS

<u>Radar Associate (Handoff) Position (RA)</u>

The position of Radar Associate (RA), also referred to as the handoff or radar data position, is designed to assist the Radar controller in performing sector functions including ensuring aircraft separation, initiating control instructions, and providing the highest level of service to the user. Most sector tasks can be accomplished by the RA, thereby allowing the Radar controller to focus on the efficient flow and separation of aircraft.

INPUTS:

- Radar display
- Manual and automated handoffs
- Radios
- Flight progress strips
- Status information area
- Coordination from tower cab, other TRACON positions and adjacent ATC facilities
- Terminal Traffic Management Unit (TTMU)
- Area Supervisor

PROCESS:

- Correlate flight progress strips and Radar display information
- Scan, analyze, transfer and file flight progress strips
- Mark flight progress strips as necessary
- Recognize, project and plan for sector workload
- Analyze traffic (e.g., volume, aircraft type and performance characteristics, requests) and evaluate additional factors (e.g., weather, equipment status, flow control)
- Monitor operations and continuously evaluate the effectiveness of the R controller's action plan

OUTPUTS:

- Ensure separation of aircraft
- Ensure adherence to procedures and flow restrictions
- Assist R controller in implementing action plan
- Initiate manual and automated handoffs
- Make entries into ARTS computer system
- Coordinate with tower cab, other TRACON positions and adjacent ATC facilities
- Initiate action as input changes

SYSTEMS:

- ICSS, RVR, ARTS, LLWAS, 24-hour clock, AWDS, IDS

Assistant Manager for Automation (AMA)

The Terminal AMA is responsible for the software maintenance program while working closely with the FAA Technical Center (FAATC) System Support Facility (SSF), Automation Specialist (AUS), AS, AM, and adjacent facilities. The AMA provides briefings to facility management on the current status, problems, and planned changes to the automation system.

INPUTS:

- Area Managers (AM)
- Area Supervisors (AS)
- Automation Specialists (AUS)
- Facility staff specialist
- Air Traffic Control Specialists (ATCS)
- Technicians
- Agency directives
- FAA Technical Center (FAATC)
- Flight progress strips

PROCESS:

- Project and plan system modifications
- Analyze effectiveness of plan
- Determine priorities
- Ensure compliance with national and regional policies

OUTPUTS:

- Make adjustments for changes (NCPs, local modifications, etc.)
- Ensure adequate system operation for users and adjacent facilities
- Coordinate operational changes that impact automation

SYSTEMS:

- ARTS, AWDS, IDS, Critical Data Recording (CDR), National Track Analysis Program (NTAP), Data Analysis and Reduction Tool DART)

Automation Specialist (AUS)

The terminal AUS is responsible for software maintenance. Expertise includes building and implementing site-specific data bases, modifying object code, assisting FAATC in the identification of software problems, collection of support data, submission of the problem description and data to the FAATC for resolution, and receiving new software versions from the FAATC.

INPUTS:

- Assistant Manager for Automation (AMA)
- Area Managers (AM)
- Area Supervisors (AS)
- Facility staff specialist
- Air Traffic Control Specialists (ATCS)
- Technicians
- Agency directives
- FAA Technical Center (FAATC)
- Computer printouts and specifications
- Flight progress strips

PROCESS:

- Analyze information and determine priorities
- Project and plan computer system and system support
- Review and evaluate proposed changes and corrections to system
- Evaluate effectiveness of plan

OUTPUTS:

- Coordinate operations
- Provide briefings to facilities management
- Ensure testing of modifications based on operational need
- Initiate action as input changes
- Develop program modifications and implementation procedures
- Coordinate with FAATC approved and suggested changes
- Maintain records and statistical data on the performance of the system

SYSTEMS:

- ARTS, AWDS, IDS, Critical Data Recording (CDR), National Track Analysis Program (NTAP), Data Analysis and Reduction Tool (DART)

ARTCC

Area Manager (AM)

The ARTCC AM is responsible for the overall ARTCC operations. Through planning, monitoring and evaluating operations, the AM uses available resources to update and accommodate traffic demands. It is a constantly changing environment where anticipating and communicating needs are as important as current operations.

INPUTS:

- Observe ARTCC operations
- Center Weather Service Unit
- Adjacent facilities
- Air Traffic Control System Command Center (ATCSCC)
- Facility Traffic Management Unit (TMU)
- Area Supervisors
- Assistant Air Traffic Manager (AATM)
- Operational Error Detection Program (OEDP)
- Military Operations Specialist (MOS)
- System engineer (SE)
- Data System Specialist (DSS)

PROCESS:

- Analyze information to determine priority of duties
- Project and plan: traffic flows, traffic management, facility procedures, weather conditions, staffing and position configurations
- Analyze, evaluate and update information as it is received to ensure effectiveness of the operation
- Monitor OEDP

OUTPUTS:

- Ensure dissemination of information from ARTCC positions, TMU, AS, and ATM that may affect operations - Coordinate with the adjacent ARTCCs, AS, TMU, and ATM
- Ensure ARTCC operations are in accordance with procedures, current flows and weather conditions
- Ensure all areas are adequately staffed
- Initiate action as conditions and operations change

SYSTEMS:

- 300 system, Host Computer (HCS), 24-hour Z-time clock, Automated Weather Display System (AWDS), Aircraft Situational Display (ASD), Meteorologist Weather Processor (MWP) or Remote RADAR Weather Display System (RRWDS), Automated Voice Network (AUTOVON).

Area Supervisor (AS)

The Area Supervisor is responsible for the operation of his/her area of specialization. There are typically four to six areas in each ARTCC. This responsibility includes observing, scanning and projecting the needs of a particular area and providing for those needs.

INPUTS:

- Observation of sector operations
- Flight progress strips
- Status information area
- Coordination from other AS positions
- Coordination with other facilities
- Traffic Management Unit (TMU)
- Center Weather Service Unit (CWSU)
- Area Manager in Charge (AMIC)

PROCESS:

- Analyze information to determine priority of duties
- Project and plan traffic flows, traffic management, facility procedures, en route/airport weather conditions, staffing and position configurations
- Analyze/evaluate effectiveness of plan

OUTPUTS:

- Ensure dissemination to appropriate positions, TMU, and AM of information concerning conditions that may affect operations.
- Coordinate with the sector positions, other AS, TMU, and AM
- Ensure sector operations are in accordance with procedures, current traffic flows, and weather conditions
- Ensure adequate staffing
- Combine/decombine sector positions as need dictates
- Initiate action as input changes

SYSTEMS:

- Host Computer System (HCS), Direct Access Radar Channel (DARC), Air Route Surveillance Radar (ARSR), Air-to-ground/Interphone Communication System, Aircraft Situation Display (ASD), 300 system

Radar Position (R)

The Radar position is in direct communication with the aircraft and has the responsibility of managing overall sector operations, including aircraft separation and traffic flows. The R controller assists the Radar Associate (RA) position with manual handoffs and coordination when needed

INPUTS:

- Pilot requests, PIREPS and SIGMETS
- Radar display
- Manual and automated handoffs
- Radios
- Flight progress strips
- Status information area
- Coordination from other radar positions, non-radar positions, and adjacent ATC facilities
- Traffic Management Unit (TMU)
- Area Supervisor in Charge (ASIC)

PROCESS:

- Prepare and monitor Radar position equipment for settings and optimum performance
- Correlate flight progress strips and Radar display information
- Manage flight progress strips: scan, analyze, transfer and file
- Mark flight progress strips as necessary
- Recognize, project and plan for sector workload
- Analyze traffic (e.g., volume, aircraft type, aircraft performance, requests) and evaluate additional factors (e.g., weather, equipment status, traffic management initiatives) and develop an action plan

OUTPUTS:

- Issue control instructions, safety alerts, advisories and information to pilots
- Initiate control instructions and ensure safe and orderly traffic flow
- Initiate manual and automated handoffs
- Disseminate weather information
- Make computer (HCS/DARC) entries
- Coordinate with other positions and adjacent ATC facilities
- Advise AS of pertinent information affecting area of primary responsibility or information affecting other areas in the ARTCC

SYSTEMS:

- HCS, DARC, ARSR, 24-hour Z-time clock, digital plan view display (PVD),300 system, Mode C Intruder

Radar Associate Controller (RA)

The Radar Associate Controller, also known as the D-side or Manual controller, is responsible for providing assistance to the Radar position (R) as necessary to ensure continued smooth operation of the sector. The RA accepts or initiates manual and automated handoffs, manages flight progress strips for the sector, and informs the R controller of all actions taken.

INPUTS:

- Requests for departure clearance
- Manual and automated handoffs
- Radios
- Flight progress strips
- Status information area
- Coordination from other controller positions
- Traffic Management Unit (TMU)
- Area Supervisor in Charge (ASIC)

PROCESS:

- Review flight progress strips for possible conflicts and advise Radar controller
- Upon receipt of flight plan/VFR departure information, ensure all required clearance items are received and recorded
- Obtain clearance from tower or formulate a clearance (e.g., IFR, Stage III, SVFR, VFR-on-top, or other VFR departure)
- Mark flight progress strips as necessary
- Ensure the accuracy of flight progress strips and place in the designated area

OUTPUTS:

- Issue clearance and deliver information to appropriate ATC facility, if applicable
- Coordinate information with other control positions
- Coordinate with TMU and/or AS
- Make computer (HCS/DARC) entries

SYSTEMS:

- HCS, DARC, 24-hour Z-time clock, 300 system

Radar Coordinator (RC)

The Radar Coordinator, also known as the Coordinator, Tracker, or Handoff controller, is responsible for performing inter- and intra-facility coordination on traffic actions, and accomplishes any other functions that will assist the Radar team in meeting situational objectives. The RC advises the Radar Associate (RA) of any action taken.

INPUTS:

- Radar display
- Manual and automated handoffs
- Radios
- Flight progress strips
- Status information area
- Coordination from other radar and/or manual positions and adjacent ATC facilities
- Traffic Management Unit (TMU)
- Area Supervisor in Charge (ASIC)

PROCESS:

- Correlate flight progress strips and radar display information
- Scan, analyze, transfer, and update flight progress strips
- Mark flight progress strips as necessary
- Recognize, project and plan for sector workload
- Analyze traffic (e.g., volume, aircraft type, aircraft performance, requests) and evaluate additional factors (e.g., weather, equipment status, flow control)
- Monitor operations and continuously evaluate the effectiveness of the Radar controller's action plan

OUTPUTS:

- Ensure safe and orderly traffic flow
- Ensure adherence to procedures and traffic management initiatives
- Assist Radar controller in implementing action plan
- Initiate manual and automated handoffs
- Make computer (HCS/DARC) entries
- Coordinate with other radar and non-radar positions and adjacent ATC facilities
- Initiate action as input changes

SYSTEMS:

- HCS, DARC, 24-hour Z-time clock, 300 system

Assistant Manager for Automation (AMA)

The Center AMA provides sir traffic management oversight to ensure the adequacy of the NAS en route automation system, its effectiveness, efficiency, reliability, functionality, and suitability for the safe and expeditious movement of aircraft.

INPUTS:

- Area Managers (AM)
- Area Supervisors (AS)
- Data System Coordinator (DSC)
- Facility staff specialists
- Air Traffic Control Specialists (ATCS)
- Technicians
- System Engineers (SE)
- Agency directives
- Computer printouts
- FAA Technical Center (FAATC)
- Contractors
- Flight progress strips

PROCESS:

- Project and plan system modifications
- Analyze effectiveness of plan
- Determine Priorities
- Ensure compliance with national and regional policies

OUTPUTS:

- Make adjustments or changes (NCPs, local modifications, etc.)
- Ensure adequate system operation for users and adjacent facilities
- Coordinate operations
- Provide direction to contractors and evaluate their activities
- Provide direction to DSC
- Staff studies of computer-related requirements

SYSTEMS:

- HCS, DARC, status panels, 24-hour Z-tame clock, 300 system, Traffic Management computer system, Display Channel Complex (DCC), Computer Display Channel (CDC), Plan View Display (PVD), Computer Readout Device (CRD)

Data System Coordinator (DSC)

The DSC provides Air Traffic expertise to ensure the adequacy of the NAS en route automation system, its effectiveness, reliability, functionality, and suitability for the safe and expeditious movement of aircraft.

INPUTS:

- Assistant Manager for Automation (AMA)
- Area Managers (AM)
- Area Supervisors (AS)
- Facility staff specialists
- Air Traffic Control Specialists (ATCS)
- Technicians
- Agency Directives
- FAA Technical Center (FAATC)
- Computer printouts and specifications
- System Engineers (SE)
- Contractors
- Flight progress strips
- Other DSCs

PROCESS:

- Analyze information and determine priorities
- Project and plan computer system and system support
- Review and evaluate proposed changes and corrections to system
- Evaluate effectiveness of plan

OUTPUTS:

- Coordinate operations
- Provide briefings to facility management
- Ensure dissemination of computer information to system users
- Assessment of computer operation
- Adjustment of computer system to provide adequate system to users'
- Initiate action as input changes
- Staff studies of computer-related requirements
- Evaluation of contractor-related activities

SYSTEMS:

- HCS, DARC, status panels, 24-hour Z-time clock, typewriter and/or PC, Traffic Management computer system, DCC, CDC, PVD, CRD, Quick-Action Keyboard MAX), 300 system

AUTOMATED FLIGHT SERVICE STATION (AFSS)

Preflight (PP)

The Preflight (PF) position is the primary position providing weather and aeronautical information and flight plan filing services to pilots prior to flight, and is staffed with certified pilot weather briefers. Briefers are expected to be familiar with current and forecast conditions while on duty. They are required to maintain comprehensive knowledge of the topographical and physical characteristics of the facility's area of responsibility. Information is provided either by telephone or face-to-face. The services are available to all users of the National Airspace System, however general aviation is the predominant user.

Preflight briefers receive a pre-duty briefing, and then continually update operational data during the tour of duty. Weather information is interpreted, translated, and summarized by the briefer, rather than read verbatim. All information and service is provided in accordance with procedural handbooks, agency and facility directives, and best professional judgment for situations not otherwise specifically addressed.

INPUTS:

- Pilots
- National Weather Service (NWS)
- National Flight Data Center/U.S. NOTAM Office (NFDC/USNOF)
- Other Facility Positions
- Adjacent control facilities
- Airport management/fixed base operators
- FSAS, M1FC)
- Charts and printed aeronautical information

PROCESS:

- Receive, analyze and respond to pilot requests for service
- Copy flight plan information
- Correctly format and transmit flight plan data

OUTPUTS:

- Preflight weather briefings
- Flight plans to ARTCCs or In Flight (IF) position
- Record of briefing via aircraft identification or pilot name

SYSTEMS:

- ICSS, Flight Service Data Processing System (FSDPS), M1FC, LABS, weather graphics, 24-hour Z-time dock

In-flight (IF)

The In-flight position provides air/ground communication with aircraft. Communication may be of a routine or an emergency nature. The position is staffed with certified pilot weather briefers. Briefers are expected to be familiar with current and forecast weather conditions while they are on duty. They are also required to maintain detailed current knowledge of the topographical and other physical features of the facility's area of responsibility. Routine services provided at the IF position include pilot weather briefings, position reporting, flight following, flight plan filing, activation, revision, and closure. Emergency services are provided in the form of orientation of lost aircraft.

INPUTS:

- Pilots
- NWS data
- NFDC
- Other facility positions
- Adjacent control facilities
- Airport management/fixed base operators
- NAVAID monitor panels

PROCESS:

- Establish priority, of duties
- Receive, analyze, and respond to pilot requests for service via two-way radio
- Copy flight plan information
- Format and transmit flight plan data
- Determine appropriate course of action in emergency situations

OUTPUTS:

- Emergency services to aircraft in flight
- In-flight weather briefings
- Pilot reports (PIREPS)
- Flight plans to ARTCCs or ATCTs
- Aircraft information to FD position
- Relay of control information
- Record of briefing with aircraft identification or pilot name
- Notification of NAVAID malfunctions
- Initiation of NOTAM action
- Initiation of Search and Rescue for overdue aircraft
- Unscheduled broadcasts
- Local airport information and advisories

SYSTEMS:

- ICSS, FSDPS, M1FC, LABS, weather graphics, Remote Maintenance Monitoring System (RMM), Direction Finder (DF), 24-hour Z-time clock

Flight Watch (FW)

The Flight Watch position is a specialized air/ground position within the FSS/AFSS facility. Service is provided between 6:00 a.m. and 10:00 p.m. on unique VHF radio frequencies (122.0 nationwide between FL 6,000 and 17,000 MSL). Discrete frequencies are used for high altitude service. The service provided is entitled En route Flight Advisory Service (EFAS). EFAS service is limited to "near-real-time" weather information, and is specifically intended for aircraft in the en route phase of flight. A primary function of EFAS is the solicitation and exchange of pilot weather reports (PIREPS) among aircraft. EFAS specialists are pilot weather briefers who have received additional specialized training and certification in the use and interpretation of weather radar and weather satellite data.

All information and service provided is in accordance with procedural handbooks, FAA orders, and facility directives.

INPUTS:

- Self briefings
- Pilots
- NWS (reports, charts, etc.)
- Other facility positions
- Adjacent control facilities

PROCESS:

- Receive, analyze and respond to pilot requests for en route weather information
- Solicit, reports from pilots (PIREPS) concerning en route conditions
- Compare PIREPS to NWS forecasts and advisories of hazardous conditions to validate the accuracy of the forecast information
- Provide to pilots the most current information available, tailored to a specific altitude and route of flight
- Refer requests for services other than EFAS to the In Flight (IF) position

OUTPUTS:

- En route flight advisories
- PIREPS
- Record of aircraft contacted via aircraft identification
- Relay of reported conditions (PIREPS) to CWSU and NWS forecasters

SYSTEMS:

- ICSS, discrete frequency outlets, FSDPS, M1FC, LABS, weather graphics, Geostationary Orbiting Environmental Satellite (GOES)imagery, weather radar displays, air traffic radar displays, 24-hour Z time clock

Broadcast (BC)

The Broadcast (BC) position is responsible for recording a number of messages concerning current and forecast weather, NOTAMS, and other significant operational information. These messages are accessible to pilots via phone, and in some cases, radio.

All information is broadcast in accordance with procedural handbooks, FAA orders, and facility directives.

INPUTS:

- National Weather Service (NWS) scheduled and unscheduled surface observations, forecasts and amendments, and weather advisories
- PIREPs
- NOTAMs
- Other facility positions
- Adjacent control facilities

PROCESS:

- Specialist assembles and edits specified weather reports and aeronautical information for various types of broadcasts in accordance with broadcast timetables
- Update broadcast recordings continually, on a scheduled or unscheduled basis, to include most current information
- Update recordings on an unscheduled basis upon receipt of significant new information such as special weather observations and newly issued or, revised weather advisory data

OUTPUTS:

- Scheduled Weather Broadcast (SWB) (Alaska only)
- Unscheduled broadcasts of weather or significant operational data
- Weather advisories (SIGMET, AIRMET, Center Weather Advisory)
- Recorded messages:
- Transcribed Weather Broadcast (TWEB)
- Pilot Automatic Telephone Weather Answering Services (PATWAS)
- Telephone Information Briefing Service (TIBS)
- Hazardous In-flight Weather Advisory Service (HIWAS)

SYSTEMS:

- ICSS, FSDPS, LABS, M1FC, communications equipment, dedicated telephone service, recording equipment, 24-hour Z-time clock

Weather Observer (WO)

The weather observer position is responsible for taking surface observations on a scheduled basis. A basic weather watch is maintained, with "record" observations taken every hour, and "special" observations taken when criteria dictates. Observations are made using a combination of visual techniques, instrument readings, and calculations. Weather observations are not taken at every FSS/AFSS location, or always by FSS/AFSS personnel at those FSS/AFSS locations that have weather observers. Weather observers are trained and certified by the National Weather Service.

INPUTS:

- Personal observation of clouds, precipitation, visibility and obstructions
- Instrument and indicator readouts of temperature, wind speed and direction and barometric pressure
- Calculations of dew point, sea level pressure and density altitude

PROCESS:

- Certified observers begin the observation of conditions so as to complete in time for scheduled transmission to Weather Message Switching Center (WMSC)
- Maintain basic weather watch
- Complete all elements of record observation in a timely manner
- Format required elements and transmit in a timely manner
- Initiate special observations when criteria so dictate

OUTPUT:

- Record special and local observations
- Climatological data
- Certified record of observations

SYSTEMS:

- LABS, Visibility chart and designated markers, temperature measuring devices, pressure indicator devices, DASI, wind instruments, local communications links, FSAS (M1FC), NADIN, ICSS, 24-hour Z-time clock

NOTAM (NO)

This position is the facility focal point for the collection, analysis and dissemination of NOTAMs. Position specialists accept and document information from all sources including other facility positions, airways facilities personnel, airport managers and operations offices, and other users. Duties include correctly formatting and transmitting data that meets handbook criteria, and maintaining the accuracy and currency of the facility files of local and FDC NOTAMs. The specialist at this position is responsible for the classification, accuracy, format, and cancellation of NOTAM information.

INPUTS:

- Other facility positions
- Adjacent control facilities
- Airways facilities personnel
- Airport management

PROCESS:

- Classify and format information received from several sources according to criteria defined in handbooks (7930.2)
- Distribute data meeting NOTAM criteria to appropriate receptors

OUTPUT:

- Local NOTAMS,
- National NOTAMS (via U.S. NOTAM System)
- NOTAM cancellations
- Dissemination of FDC NOTAMS to adjacent control facilities
- Permanent changes to NFDC for publication

SYSTEMS:

- FSAS (FSDPS, M1FC), ICSS, USNS

Flight Data (FD)

Flight Data is an internal/external communication position within the FSS/AFSS. It is the focal point for messages such as flight plans, flight movement and notification data, and administrative message traffic. Search and Rescue (SAR) activities are also initiated from this position on aircraft that become overdue.

INPUTS:

- Other FSS/AFSS positions
- Flight plans
- Flight plan activation/cancellation
- Search and Rescue (SAR) initiation
- Other FSS/AFSS facilities
- Requests for arrival information
- SAR data
- Administrative messages

PROCESS:

- Receive IFR flight plans and other movement messages from other positions.
- Properly format flight plans and other pertinent data for transmission
- Initiate and respond, to SA messages in a timely manner based on established criteria and procedures
- Perform SAR duties as required
- Format and transmit administrative messages

OUTPUTS:

- SAR information to other facilities/positions
- Flight plan closure/cancellation data to ATC facilities
- Relay of administrative traffic
- Transmit flight plans, flight movement/notification messages and administrative message traffic

SYSTEMS:

- FSAS (M1FC), ICSS, LABS

Area Supervisory (AS)

The FSS/AFSS area supervisor is responsible for overall facility operations during an assigned shift. Duties include ensuring adequate staffing for the operational situation, monitoring of all operational positions, ensuring that all functions are performed in accordance with various directives, and making timely notification in the event of equipment malfunctions.

INPUTS:

- Visual observation of positions
- Notification by specialists of unusual situations
- Coordination with other facilities

PROCESS:

- Continually analyze operational situation and assign duties in accordance with priority of duties

OUTPUT:

- Operational direction and guidance as needed
- Management of available resources

SYSTEMS:

- FSAS (M1FC), LABS, weather graphics system, ICSS, NAVAID monitor systems

Assistant Manager for Automation (AMA)

The Flight Service AMA is responsible for managing the operation of the FSDPS stag' and host computer that serves 2-6 AFSS sites. The AMA monitors the application software and provides periodic system analysis to ensure operational acceptability. The AMA maintains a close liaison with regional and national offices. The AMA supervises a staff of 6-8 people. This position requires close coordination with several operational facilities including AFSS site users, WMSC, AWP, FAATC, and NADIN.

INPUTS:

- Area Managers (AM)
- Area Supervisors (AS)
- Automation Specialists (AUS)
- Facility staff specialist
- Air Traffic Control Specialists (ATCS)
- Technicians
- Agency directives
- FAA Technical Center (FAATC)
- Computer printouts
- Aviation Weather Processor (AWP) managers

PROCESS:

- Project and plan system modifications
- Analyze effectiveness of plan
- Determine priorities
- Ensure compliance with national and regional policies
- Maintain system operational security
- Ensure recurrent training

OUTPUTS:

- Make adjustments for changes (NCPs, local modifications, etc.)
- Ensure adequate system operation for users and adjacent facilities
- Coordinate operations
- Certify accident and incident packages for AFSS sites

SYSTEMS:

- M1FC, Flight Service Data Processing System (FSDPS), Data Scope Monitors, National Airspace Data Interchange Network (NADIN), LABS, Weather Message Switching Center (WMSC), Aviation Weather Processor (AWP), ICSS

<u>Automation Specialist (AUS)</u>

The Flight Service AUS is responsible for maintaining the operation of an FSDPS host computer that serves between 2-6 sites; monitors the application software and provides periodic system analysis to ensure operational acceptability; resolves problems with the FSDPS system software and hardware; coordinates closely with Area Supervisors in the AWP, WMSC, NADIN, and AFSS facilities; verifies the accuracy of data base and software. versions; installs new revisions; maintains data base integrity; and performs system restarts and performance monitoring.

INPUTS:

- Assistant Manager for Automation (AMA)
- Area Managers (AM)
- Area Supervisors (AS)
- Facility staff specialist
- Air Traffic Control Specialists (ATCS)
- Technicians
- Agency directives
- FAA Technical Center (FAATC)
- Computer printouts and specifications Aviation Weather Processor (AWP) supervisor NADIN Interface
- Weather Message Switching Center (WMSC) interface

PROCESS:

- Analyze information and determine priorities
- Project and plan computer system and system support
- Review and evaluate effectiveness of plan
- Maintain computer operation
- Implement new software and data base versions
- Reconfigure failed system components
- Archive historical data for 2-6 AFSS sites
- Perform system analysis for problem detection
- Perform, system diagnostics

OUTPUTS:

- Coordinate operations
- Provide briefings to facility management
- Initiate program technical reports
- Prepare accident and incident packages for AFSS sites
- Develop program enhancements for national software
- Coordinate changes in software and/or database with servicing facilities

SYSTEMS:

- M1FC, Flight Service Data Processing System (FSDPS), data scope monitors, interface and coordination with NADIN, WMSC, LABS, AWP, ICSS

TRAFFIC MANAGEMENT

National Traffic Management Officer (NTMO) - ATCSCC

NTMOs gather information from a variety of sources to determine the status of the NAS; analyze system constraints, traffic demand, and the capacities of airspace and airports; develop a strategy of traffic management initiatives to balance demand and capacity; supervise the implementation and management of initiatives, disseminate traffic management and delay information to users and field traffic management personnel; and monitor, evaluate, and critique the effectiveness of traffic management initiatives.

INPUTS:

- Official Airline Guide (OAG)
- Host flight plan data
- Aircraft Situational Display (ASD)
- Operational Acceptable Levels of Traffic (OALT)
- Engineered Performance Standards (EPS)
- Airport Arrival Acceptance Rate (AAR)
- Weather data (MWP, CFWSU)
- Air Traffic Control facility personnel
- ARTCC and Terminal traffic management personnel
- FAA Washington Operations Center (WOC)
- Central Altitude Reservation Function (CARE)
- Users (airlines, military, law enforcement, general aviation)
- National Flight Data Center (NFDC)

PROCESS:

- Use inputs to gather information about the status of the NAS including system constraints, airport capacities, traffic demand, and other conditions that could cause operational problems
- Develop a system-wide strategy of traffic management initiatives necessary to balance demand with capacity --Coordinate and disseminate information concerning the status of the NAS and Traffic Management initiatives --Establish priorities and assign work to Traffic Management Specialists to achieve maximum efficiency and utilization of operations personnel
- Provide guidance and assistance to TMSs assigned to severe weather management
- Manages the day-to-day airport reservation operation

OUTPUTS:

- Approves or disapproves traffic management initiatives
- Monitors, evaluates, and critiques the performance of approved Traffic Management initiatives
- Approves or disapproves additional arrival and departure slots for airports in the airport reservation operation . -Conducts scheduled and special telephone conferences with users

and regional and ATC facility traffic management personnel to inform them of local or national traffic management initiatives and to advise of current and anticipated delays and airspace/airport conditions

SYSTEMS:

- Aircraft Situation Display (ASD), Specialist workstations, ETMS processor, PDPs, long-line and commercial telephone, 24-hour Z-time clock, Dynamic Ocean Track System (DOTS), Meteorologist Weather Processor (MWP), printed planning charts, large screen displays, Special Use Airspace Management System (SAMS), High Altitude Route System (HARS), Automated Voice Airport Reservation System (AVARS).

Traffic Management Specialist (TMS) - ATCSCC

TMSs/NTMOs gather all the pertinent information relative to current and projected future operations, and develop tentative TM plans to balance demand with capacity; initiate and implement TM plans with other facilities/TMUs, supervisors and control specialists and the ATCSCC; maintain awareness of capacity reductions throughout the NAS; document delay information; evaluate effectiveness of TM initiatives and make necessary adjustments.

TMSs disseminate TM initiative information to users and TMUs via ATCSCC advisories and records delay information. NTMOs coordinate the efforts of TMSs into a coordinated NAS Traffic Management Plan.

INPUTS:

- Official Airline Guide (OAG)
- Aircraft Situation Display (ASD)
- Host flight plan data
- Operational Acceptable Levels of Traffic (OALT)
- Engineered Performance Standards (EPS)
- Arrival Acceptance Rate (AAR)
- Weather data (FT, SA, CFWSU)
- Coordination with other ATC facilities
- ATCSCC Operations Center
- Central Altitude Reservation Center (CARF) users (airlines, military, general aviation)

PROCESS:

- Use inputs to gather information for airports and en route sectors within the NAS to assess their current and forecasted capacities
- Develop and implement Traffic Management initiatives necessary to balance demand with capacity
- Limit restrictions to increase capacity of the NAS through close coordination of individual en route and terminal Traffic Management initiatives
- Generate transcontinental routes for use between specified city pairs

OUTPUTS:

- Traffic Management Initiatives:
    - Mile/minutes in-trail restrictions
        - Local ground delay programs
    - Arrival spacing (ASP)
    - Arrival fix balancing
    - Flight reroutes
    - Traffic stops
    - Transcontinental routes

    - Exemptions from TM initiatives
- Coordination with:
    - National Traffic Management Offices (NTMOs) and TMSs/TMCs to implement traffic management initiatives and flight reroutes
    - Traffic Management Units (TMU)/TMCs to maintain awareness of current and anticipated conditions
    - Users, to inform them of local/national TM initiatives and advise of current and anticipated delays and airspace/airport conditions

SYSTEMS:

- Aircraft Situation Display (ASD), ETMS processor, PDPs, long-line and commercial telephone, 24-hour Z=time clock, Dynamic Ocean Track System (DOTS), Meteorological Weather Processor (MWP), printed planning charts, large screen displays, Special Use Airspace Management System (SAMS)

Supervisory Traffic Management Coordinator (STMC) - En route

STMCs are responsible for assessing the capacity and demand for airspace and airports within their facility's area of responsibility; developing and administering traffic management initiatives including arrival and departure metering, en route spacing, ground delays, and severe weather avoidance routes; providing intra- and inter-center coordination on military aircraft missions and airspace usage; disseminating weather information to center personnel and to other air traffic facilities in their area of responsibility; and assigning work within the Traffic Management Unit to ensure the most effective use of resources.

INPUTS:

- Official Airline Guide (OAG)
- Host flight plan data
- En route radar
- Aircraft Situational Display (ASD)
- Operational Acceptable Levels of Traffic (OALT)
- Engineered Performance Standards (EPS)
- Airport Arrival Acceptance Rate (AAR)
- Weather data (MWP, CWSU)
- Air Traffic Control facility personnel
- En route Terminal traffic management personnel
- Air Traffic Control System Command Center (ATCSCC)
- Central Altitude Reservation Function (CARF)
- Users (airlines, military, law enforcement, general aviation)
- National Flight Data Center (NFDC)

PROCESS:

- Use inputs to gather information about the status of the airspace and airports within the Center's boundaries. Considerations include weather, system constraints, airport capacities, traffic demand, and other conditions that could cause operational problems
- Develop a strategy of traffic management initiatives necessary to balance demand with capacity
- Coordinate and disseminate information concerning the status of the NAS, weather, traffic management initiatives, and military airspace and mission requirements to personnel within the facility, sir traffic facilities with adjacent airspace, and the ATCSCC
- Establish priorities and assign work to TMCs to achieve maximum efficiency and utilization of operations personnel
- Monitor and evaluate traffic management initiatives to ensure effectiveness.

OUTPUTS:

- Develops, implements, monitors and analyzes traffic management initiatives specific to the facility's area of responsibility

- Utilizes available resources to ensure balanced traffic flows and the maximum utilization of airspace
- Balances and meters traffic into airports in the Center's area of responsibility
- Manages airport departure flows to meet en route restrictions
- Implements traffic management initiatives requested by adjacent facilities and the ATCSCC
- Coordinates weather, traffic management, and other information pertaining to the efficient operation of the NAS to concerned personnel

SYSTEMS:

- En route radar and Host computer through PVDs and KVDTs; Aircraft Situation Display (ASD); specialist's workstation; ETMS processor; interphone, dedicated long-line, and commercial telephones; 24-hour Z-time clock; walkie-talkie; Meteorologist Weather Processor (MWP); printed planning charts; Special Use Airspace Management System (SAMS); Dynamic Ocean Track System (DOTS).

Traffic Management Coordinator (TMC) - Tower

Tower TMCs gather all necessary information and develop tentative TM plans to balance demand with capacity; negotiate tentative TM plans with terminal/en route TMC/TMUs, supervisors, control specialists, and the ATCSCC; maintain awareness of capacity reductions outside their area of responsibility; calculate delay information; evaluate effectiveness of TM initiatives and make necessary adjustments; disseminate TM initiatives to supervisory/control personnel, approach controllers, and parent TMU; and forward delay information to parent TMU.

INPUTS:

- BRITE terminal Radar
- Host flight plan data
- Engineered Performance Standards (EPS)
- Weather data (FT, SA, CWSU)
- Traffic Management Unit (TMU) - ARTCC
- Air Traffic Control System Command Center (ATCSCC)
- Users (Airlines, Military, General Aviation)
- Aircraft movement (visual)
- Airport manager

PROCESS:

- Gather information about terminal/en route sectors
- Assess current and forecasted capacities at the airport and develop or recommend Traffic Management (TM) initiatives necessary to balance demand with capacity and meet terminal and en route sector requirements

OUTPUTS:

- Traffic Management Initiatives (strategic/tactical):
    - Final spacing
    - Flight reroutes
    - Traffic stops
- Coordination with:
    - SATCs/ATCSs (internal) to implement traffic management initiatives and flight reroutes
    - Traffic Management Unit (TMU)/TMCs with parent terminal facilities to maintain awareness of current and anticipated conditions.
    - ATCSCC to advise of current and anticipated airport delays and airspace/airport conditions

SYSTEMS:

- Flight Data Input/Output (FDIO), interphone, long-line and commercial telephone, 24-hour Z-time clock

Traffic Management Coordinator (TMC) - TRACON

TMCs gather all necessary information and develop tentative TM plans to balance demand with capacity; negotiate tentative TM plans with other terminal facilities, parent TMU, supervisors, control specialists and the ATCSCC; maintain awareness of capacity reductions outside their area of responsibility; calculate delay information; evaluate effectiveness of TM initiatives and make necessary adjustments; disseminate TM initiatives to supervisory/control personnel, towers, approach controls, and other TMUs via the ATCSCC; and forward delay information to the ATCSCC.

INPUTS:

- Host flight plan data
- Terminal Radar
- Engineered Performance Standards (EPS) Weather data (FT, SA, CWSU)
- ATCs and SATCs (towers/ARTCCs)
- Air Traffic Control System Command Center (ATCSCC)
- Users (airlines, military, general aviation)

PROCESS:

- Gather information for airports and terminal sectors within their airspace to assess current and forecasted capacities
- Develop or recommend Traffic Management (TM) initiatives necessary to balance the demand with the capacity.

OUTPUTS:

- Traffic Management initiatives (strategic/tactical)
    - Mile/minutes in-trail restrictions, arrival spacing
    - Arrival fix balancing
    - Flight reroutes
    - Traffic Stops
- Coordination with:
    - SATCs/ATCSs (internal) to implement traffic management initiatives and flight reroutes
    - Parent Traffic Management Units (TMU)/TMCs, adjacent/ other terminal facilities to maintain awareness of current and anticipated conditions
    - ATCSCC to advise of current and anticipated delays and airspace/airport conditions

SYSTEMS:

- Aircraft Situation Display (ASD), Terminal Radar/ARTS, Flight Data Input/Output (FDIO), interphone, long-line and commercial telephone, 24-hour Z-time clock

Traffic Management Coordinator (TMC) - En route

TMCs gather all necessary information and develop tentative TM plans to balance demand with capacity; and negotiate tentative TM plans with other facilities and TMUs, supervisors, control specialists and the ATCSCC. They maintain awareness of capacity reductions outside their area of responsibility; calculate delay information; evaluate effectiveness of TM initiatives; and make necessary adjustments to disseminate TM initiatives to supervisory and control personnel. This includes towers, approach control facilities, and other TMUs via the ATCSCC. TMCs also forward delay information to the ATCSCC.

INPUTS:

- Official Airline Guide (OAG)
- Aircraft Situation Display (ASD)
- Host Flight plan data
- Operational Acceptable Levels of Traffic (OALT)
- Engineered Performance Standards (EPS)
- Weather data (FT, SA, CWSU)
- ATCSs and SATCSs, (towers, TRACONs, ARTCCs)
- Users (airlines, military, general aviation)

PROCESS:

- Gather information for airports and en route sectors within their ARTCC to assess current and forecasted demand and capacities
- Develop or recommend Traffic Management (TM) initiatives necessary to balance the demand with the capacity

OUTPUTS:

- Traffic Management initiatives (strategic and tactical)
    - Mile and minutes in-trail restrictions, local ground delay programs, arrival spacing
    - Arrival fix balancing
    - Flight reroutes
    - Traffic Stops
- Coordination with:
    - SATCSs and ATCSs (internal) to implement traffic management initiatives and flight reroutes
    - Traffic Management Units (TMU/TMCs in adjacent ARTCCs and terminal facilities to maintain awareness of current and anticipated conditions
    - ATCSCC to request national TM initiatives and advise of current and anticipated delays and airspace and airport conditions

SYSTEMS:

- Host PVD and KVDT, Aircraft Situational Display (ASD), Flight Data Input/Output (FDIO), interphone, long line and commercial telephone 24-hour Z-time clock, Dynamic Ocean Track System (DOTS), MWP, walkie-talkie.